Concrete

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Placing 350,000 Cubic Yards of Concrete in Ariel Dam

Operate Three 2-Yd. Mixers—Aggregates Produced on Site and All Sizes Up to 6-In. Utilized—Fill 2-Ft. Construction Joints After Concrete Shrinks

By W. A. SCOTT
Portland, Oregon

THE construction of the Ariel dam and power-house, on the Lewis River, in Washington, is scheduled for completion by May, 1931. Of the total of 350,000 cu. yds. of concrete required in the entire structure there remained only about 50,000 yds. to be placed after January 1. This is the project of the Inland Power & Light Company, a subsidiary of the American Power & Light Company, New York. The construction contract is being put through by the Phoenix Utility Company, and the property on completion, is to be taken over and operated by the Northwestern Electric Company, Portland, Oregon, as lessee.

Dam, Water Storage and Power Plant

The project plans, as worked out by the engineers of the Electric Bond & Share Company, New York, involved the construction of a dam for the storage of 220,000 acre-feet of water, and the building of a hydro-electric plant to be equipped, ultimately, with four generating units, each of the capacity of 45,000 kw. The installation of the initial unit was well advanced on January 1. The other three units are to be installed at later dates as demands for power may require.

Project Expenditures

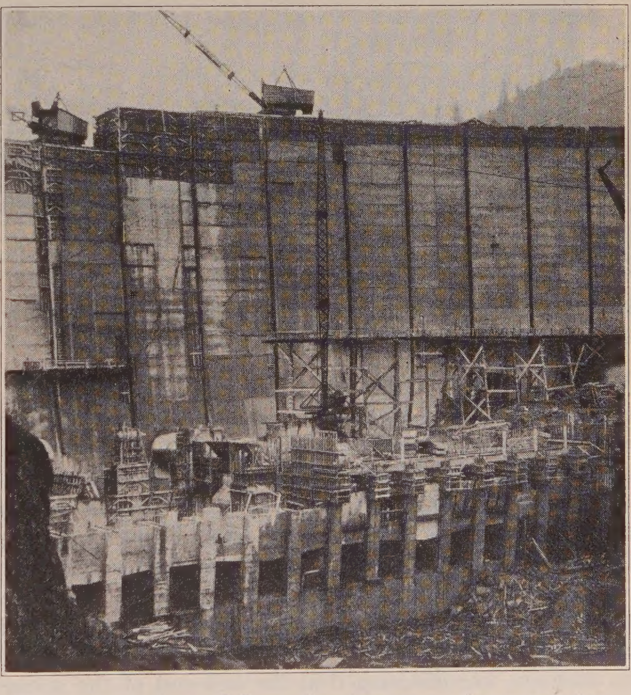
The owner company, by April of this year, will have spent close to $8,500,000 on the project. This sum covers the costs of surveys, engineering, diamond drill exploration at the dam site, and all construction work under the Phoenix Utility Co. contract. The purchase and installation of equipment for the second, third and fourth generating units, however, are not included. The ultimate expenditure for this entire development is estimated at $12,500,000.

River Diversion and Excavations

The driving of a 1,462-ft. diversion tunnel, the construction of upper and lower cofferdams, the unwatering of the dam site area, and the excavation and disposal of 350,000 cu. yds. of material, although highly important work, need not be included in the scope of this article. That which follows, then, pertains to the production, delivery and placing of concrete of a specified mix for the construction of the dam and power-house.

Production of Concrete

The contractor's layout for producing concrete involved the installation of equipment for the recovery of sand, gravel and cobbles from a river deposit, a washing and screening station, bulk cement storage, a proportioning and mixing plant, and belt conveyors for moving material. All these constituted a system of operating units that was planned by the engineers of the Phoenix Utility Company,



Downstream face of dam, showing stage of construction of power-house on December 15, 1930 collaborating with those of the Smith Engineering Co., Milwaukee, and Sauerman Bros., Inc., Chicago.

Taking Material from River Deposit

Materials for mineral aggregate are taken from the stream below the lower cofferdam with two slack-line cableways, having 2-yd. buckets. Each unit is operated from a double-drum hoist, driven by a 150-hp. motor. There is a span of about 1,000 ft. between the two cableway masts on the north bank and the two tail towers and anchorages on the opposite shore. The material is dumped at the north bank into a bunker from which it is discharged into a shaking feeder, operated by a 5-hp. motor through belt connection to an eccentric shaft. It passes from the feeder onto an inclined grizzly, the oversize feeding into a gyratory crusher. The crusher product and the grizzly undersize feed onto a 24-in. belt conveyor by which this unclassified material, running from 6-in. cobbles down to fine sand, is delivered to the washing and screening plant. This conveyor, of 6-ply belting, has an extent of 466 ft. between centers, runs on an 18 per cent incline, is driven at a speed of 225 ft. per min. by a 60-hp. motor, and has a capacity of over 200 cu. yd. per hour.

Washing and Classifying

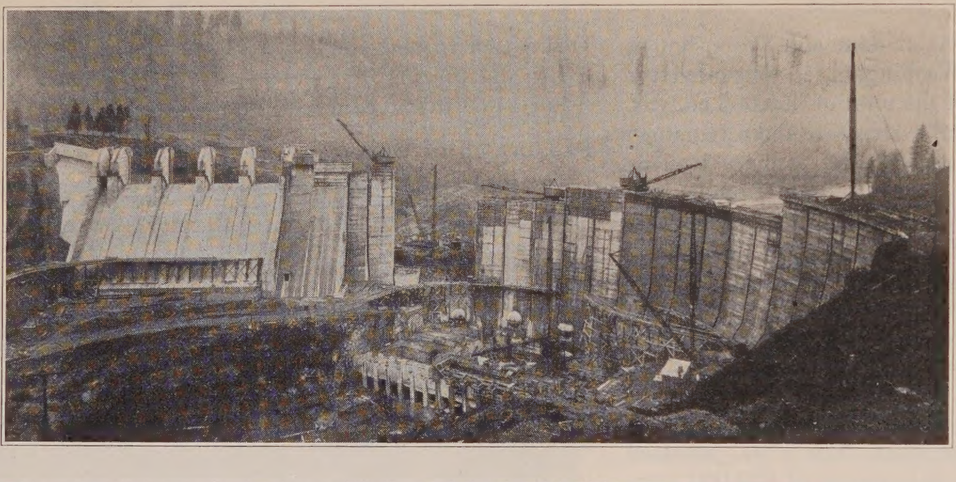
At the classifying plant, the material passes from the conveyor into a revolving wet screen, 14 ft. long, 60 in. diameter, operated by a 20-hp. belt-connected motor. The wash water is supplied from a 6-in. perforated pipe at the screen center. Eleven lineal feet of the screen has 1½ in. openings, the first 3 ft. at the feed end being a blank section. A sand jacket, 6 ft. long, of 5/16-in. wire mesh, is carried on the outer circumference of the main screen, near the head end. The cobbles, grading from 1½ in. to 6 in., are discharged at the tail end of the screen; the gravel, from 1½ in. minus to 5/16, is passed by gravity to stock-piles. The sand-jacket product, running 5/16-in. minus, is washed into an automatic settling tank, from which the slimes overflow. The settled sand discharges into a twin-screw rewasher, producing clean sand that feeds onto a short conveyor and discharges to the sand stock-piles.

Handling Classified Aggregates

The movement of the classified aggregates from the stock-piles to the batching and concrete mixing plant is by means of a 24-in. belt conveyor that covers a distance of 460 ft. between pulley centers. The first half is operated horizontally in a tunnel that cuts under the stock-piles. The other half extends from the mouth of the tunnel, up a 15 per cent incline, to the storage bins above the weighing hoppers and mixers. Aggregates are drawn from the stock-piles through hand-operated gates onto the tunnel section of the conveyor. This conveyor delivers one grade at a time into a ball-bearing, swivel-like distributing hopper in the top part of the storage and mixer building, whereby any class of aggregate may be turned into its designated bin. On this floor there are bins for the three grades of aggregates and a bin for bulk cement.

Storing and Conveying Bulk Cement

Bulk cement for the job is delivered in railroad cars at Woodland, and is hauled thence in 50-bbl. trucks to bulk-cement storage, at the dam site, a distance of 12 miles. The v-shaped storage bin is 100 ft. long and holds 3,800 bbls. of bulk cement. Its location is 300 ft. from the mixing plant, but on higher ground. The cement feeds through the v-bottom of the bin to two spiral conveyors, each 48 ft. long. The two discharge at a common center onto a 14-in. belt conveyor, 290 ft. long. This belt operates within a timber-built gallery and discharges the cement into a bin over the weighing hoppers, adjacent to the aggregate bins.



General view of dam on December 15, 1930. Section near center left open for flood waters

Concrete Batchers

Two sets of weighing hoppers serve in making up batches for the three Smith 2-yd. mixers. The batchers were built by the Blaw-Knox Company, after designs by the engineers of the Northwestern Electric Co. Each set consists of two weighing hoppers—one for the aggregates and one for the cement.

Make-Up of the 2-Yd. Batch

The constituents of the standard 2-cu. yd. mixer batch of concrete, by weight, are as follows:

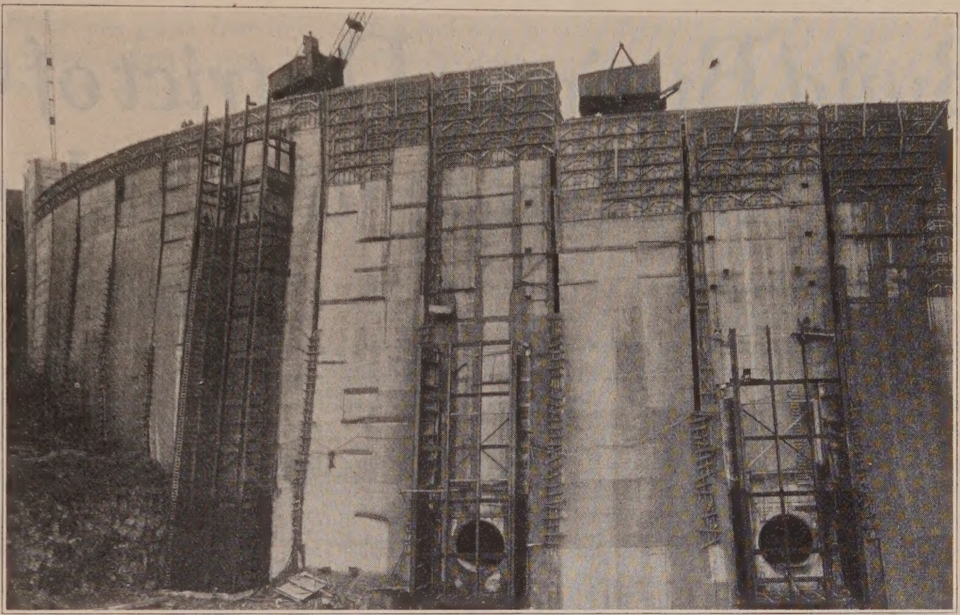
Cement, 752 lbs.
Sand, 5/16 in. down, 1,900 lbs.
Pebbles, 5/16 in. to 1½ in., 1,450 lbs.
Cobbles, 1½ to 6 in., 3,450 lbs.

The water-cement ratio in the mixer batch is from 0.9

to 1, or 6¾ to 7½ gals. of water per sack of cement, including free water in the aggregates. The mixture thus constituted gives a strength of concrete, at 28 days, of 2,400 to 3,000 lb. compression per sq. in.

Handling and Placing Concrete

Batches of concrete are dropped from the mixers into 2-yd. bottom-dump buckets, carried on small flat-cars, the latter being drawn in short trains over industrial tracks by gasoline locomotives. Under this flexible arrangement, the cars, with their buckets of concrete, are pulled alongside any section of the dam being built, each bucket being lifted by one of the cranes or derricks to any point on the dam where the concrete is being placed. The hoisting and distributing equipment used for this work comprises three cranes and four derricks. Each crane is equipped with a 75-hp. motor, a 3-drum hoist and a 75-ft. boom. The power for the motor drives is tapped off a 440-volt line from the local substation. In connection with this method of concreting, a mechanical tamper of Briggs & Stratton make is used.



Upstream face of dam, showing 2-ft. open construction joints to be filled after shrinkage of concrete. Penstock openings shown

The Arch Section of Dam

The arch section of the Ariel dam, that stretches across the river canyon, has a length of 700 ft. at the crest and about 50 ft. at bedrock. The arch curves on a variable radius, running from 200 ft. at the base to 400 ft. at the top. This section has a height of 313 ft., measured from El. minus 73 at bedrock to El. 240 at the crest, the latter being at a height of 190 ft. above the normal stream bed. At the base of the arch section the structure has a thickness of 93 ft., tapering to 18 ft. at the top. The south end of the arch is built into and braced against an excavated cut in the canyon wall. At the north end it makes a juncture on the north shore with a concrete thrust block, 65 ft. high, 75 ft. long and 115 ft. thick at the toe, its base being at a level of 30 ft. above the river bed.

The spillway section has a length of 206 ft. between the thrust block and the north abutment. Included in this length is the space occupied by five concrete piers that support four gates, each 39 ft. long and 35 ft. high. The spillway crest is at El. 205, which is 35 ft. below that of the arch section. During flood-water periods this spillway will discharge at the rate of about 120,000 cu. ft. per second.

The north abutment section extends out 242 ft. from the north end of the spillway. This is based on higher ground and was built up to its full height last autumn.

Expansion and Contraction Joints

Expansion and contraction joints for all sections of the dam are placed at an average of about 30 ft. apart. Joints in the arch section are 2 ft. wide, allowing the arch to be built up in 30-ft. sections, separated by 2-ft. slots, which are filled with concrete after the sections have taken their shrinkage. The spillway contraction joints were grouted through a series of pipes after shrinkage.

Power-House

The power-house, of concrete and steel construction, now practically completed, was placed immediately downstream from the arch section of the dam. The structure has a length of 250 ft. crosswise of the canyon, and a width of 100 ft. The center section of the building, running across a box-canyon section, is supported by an arch structure of concrete and steel. The arch has a span of 73 ft. between haunches and a rise of 39 ft. at the center, the archway extending 100 ft. up- and downstream. The parts of the sub-structure on both sides of the arch rest upon the solid rock of the canyon sides.

Penstocks

The four penstocks, each of 15½ ft. diameter, were built into the arch section of the dam at El. 60. A butterfly valve, operated from the downstream face, and an emergency gate at the upstream face, will control the flow of water through the initial penstock, soon to be in use. The center line of the turbine of each unit will be at the same elevation as that of the penstock.

By reference to one of the illustrations, it will be noted that a 98-ft. gap in the dam appears on the north shore. This segment was left uncompleted in December to allow the passage of any possible flood water during late winter months. It is figured that this gap will be concreted in March and that the diversion tunnel will be closed about April 1. Meanwhile, the 2-ft. slots at expansion joints will be filled, which will require about 12,000 cu. yd. of concrete.

L. T. Merwin, vice-president and general manager for the Northwestern Electric Company, is executive officer on the work; H. F. Lincoln, construction manager; D. W. Cole, engineer for the Electric Bond & Share Company, New York, consultant as to concrete construction; Lyman Griswold, consulting engineer for the Northwestern Electric Company; O. L. LeFever, superintendent for Northwestern Electric Company, supervisor as to mechanical and electrical equipment.

Build Business District of Concrete in Residential Suburb

To supply the shopping needs of its 10,000 residents, developers of Highland Park, Texas, an incorporated suburb of Dallas, are constructing a unique Spanish village modeled after one of the units displayed at the Exposition of Spanish Provinces held at Barcelona in 1929. When completed, this unusual community will comprise seventy-five shops of various kinds, a complete theater, and sufficient automobile service stations to accommodate the needs of motorists.

Monolithic concrete, concrete masonry and stucco with cast stone trim are being used to re-create the truly Spanish atmosphere from which the village is modeled. This type of construction is also admirably suited to the general excellence of development that has made Highland Park one of the five outstanding residential communities in the United States.

Developed by Landscape Architects

The talent of such landscape architects as the late George E. Kessler and of Wilbur David Cook and Hase and Hase have guided the residential development of the community since its inception twenty years ago.

Commencing with nothing more than winding Turtle Creek with its rock-lined banks, these landscape artists changed 1400 acres of open prairie land into a residential town of surpassing beauty. Concrete dams placed across the creek at proper intervals provided a beautiful stream on which boating and fishing can be enjoyed during all seasons. Boulevards were built along its winding banks as the nucleus of a street system noted for its completeness and beauty. Public parks and playgrounds with concrete swimming pools and tennis courts supply ample outdoor recreation. The generous size of building lots has allowed the construction of imposing and luxurious homes.

Solve Old Problem in New Way

The planning of commercial buildings in such a carefully developed residential community naturally presented an unusual problem.

After much thought and discussion, Hugh Prather, of the Flippen-Prather Realty Company, decided that some type of continental architecture would be appropriate and desirable. Accompanied by James B. Cheek, of Fooshee and Cheek, Dallas architects, a tour was made of various European countries. At the Barcelona International Exposition Mr. Prather found village layouts that appealed to him more than any others he had previously seen. From

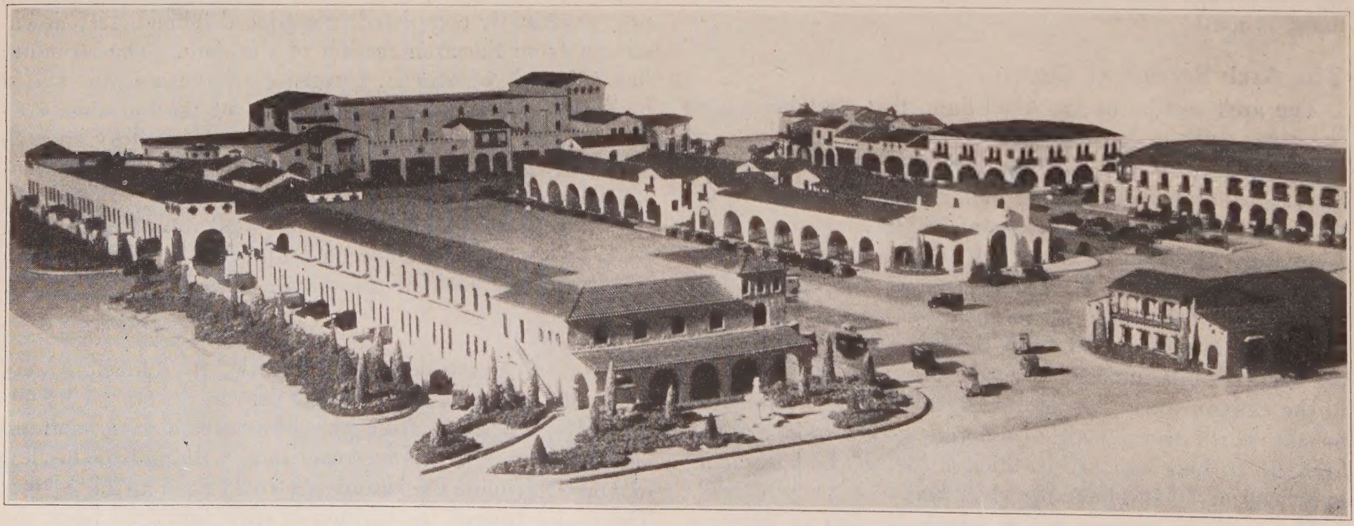


Figure 1. General view of model of business district for Highland Park, suburb of Dallas, Texas

Spanish Village Layout Solves Old Problem in New Way—Generous Use of Cast Stone, Concrete Masonry, Stucco and Monolithic Concrete

this village display, one was selected as a model for Highland Park.

Follow Spanish Village Layout

Returning to Dallas, the architect was given free rein to adapt the Spanish practice of village layout to meet the requirements of an American shopping center. Figure 1 shows the results.

Will Utilize 100,000 Masonry Units

The seventy-five shops in the village will be entirely of concrete and concrete masonry. Over 100,000 concrete tile units will be required for the masonry construction. The monolithic construction will be similar to that which is so popular on the Pacific Coast. All buildings will have concrete floors and steel sash as further measures of fireproofing.

A complete system of storm and sanitary sewers has been installed by the owners. Other necessary utilities have also been provided. All streets and alleys have been paved and will be illuminated by boulevard lights.

This development was planned by the Flippen-Prather Realty Company and it is believed that the unique and durable construction which is being provided will prove unusually profitable to the owners as well as the community.

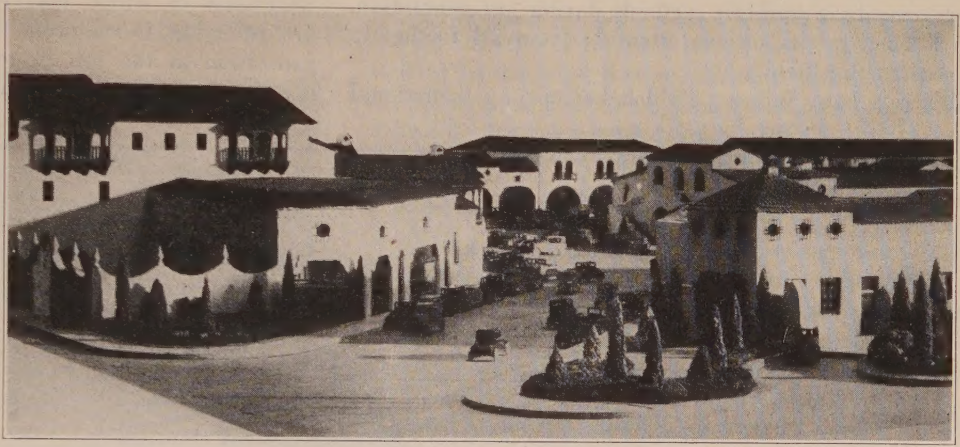


Figure 2. One of two entrances to business district

It will be seen that shops line all sides of the 600 by 700-foot rectangle with a double row in the center. The inside rows of shops face one another and have display windows and entrances on a narrow stepped street typical of the Plaza del Rey at Barcelona.

Figure 2 shows a close-up of one of the two wide entrances from outside streets. These two entrances are the only means of passage to and from the village. A paved court in the center provides parking space for 700 cars. Ample use is being made of shrubbery and Spanish embellishments.

Generous Use of Cast Stone

The massive arched entrances and stone doors of the buildings have been reproduced in cast stone with a travertine finish by the Dallas Architectural Decorating Company. Some of the arch units weigh more than 3000 pounds each. All stone is dry tamped. The finish is obtained by sprinkling ice cream salt into the molds before the facing is placed and tamped. During the curing period the salt is dissolved by frequent washing. The holes left by this process provide a rugged, porous finish.

An unusually pleasing color was obtained by using white portland cement with a coarse, whitish Texas stone and river sand. The proportions were 1:1½:1½. This color produces a much more desirable effect than the pure white of the European villages usually obtained with whitewash.

Cast Stone Institute Appeals Order of Federal Trade Commission

Taken Before Fifth District Federal Court—Decision Involves Right to Use of Term "Cast Stone"

The Cast Stone Institute has appealed against the recent decision of the Federal Trade Commission which denies the right to the use of terms such as "cast stone" or "stone" unless qualified by such words as "imitation" or "artificial." The appeal was taken before the federal court of the fifth district.

The commission's order applies specifically to a large southern concern which heretofore has been advertising products composed principally of cement and crushed stone under the name of "cast stone," pink marble," and under other names.

Specification Problems Before Pipe Manufacturers' Convention

Concrete pipe manufacturers, members of the American association, meeting in their two-day, twenty-fourth annual convention at the Edgewater Beach Hotel, Chicago, February 23 and 24, as CONCRETE goes to press, are interested particularly in the subject of specifications.

M. W. Loving, secretary, is in charge.

Commercial and Production Aspects of Ready-Mixed Concrete

Objective Is Better Concrete — Small Job Gets High Quality Concrete — Must Deliver When Needed — Big Variation in Demand Makes Heavy Plant Investment Necessary

By H. F. THOMSON
Vice-President, General Material Co., St. Louis, Mo.

READY-MIXED concrete should not be viewed as a panacea for concreting troubles, nor as a get-rich-quick scheme. Rather, it represents one of the noteworthy improvements in building methods during our generation, and as such merits serious attention from all factors in the construction field.

Fyler Avenue ready-mixed concrete plant of the General Material Company of St. Louis

This is a baby industry, which has sprung to national size within a comparatively few years. As late as 1927, the Biennial Census of Manufactures did not list ready-mixed concrete. But in the census in 1929 ready-mixed concrete, or "Pre-mixed Concrete," was credited with an output valued at approximately seven and one-half million dollars, which value was probably incomplete because of being listed for the first time. But even so, this value was exceeded among items in the concrete products division only by building units and concrete pipe. In the year 1930, upward of six million cubic yards of concrete were delivered by commercial companies, valued at about forty million dollars, which undoubtedly marks this as the largest division in the concrete products field.

The terms "pre-mixed" or "pre-manufactured" are sometimes preferred to the expression "ready-mixed," but regardless of which descriptive designation is used, we are referring to concrete furnished the construction organization at the job in ready-to-use condition. This is not the place to debate the relative merits of different methods of operation or types of equipment, such as central or truck-mixing operations, or agitation or non-agitation delivery. In a broad sense, all such operations represent the servicing of ready-to-use concrete and they differ chiefly in the detail of the choice of equipment.

"Better Concrete"

This new industry deserves credit for pointing the way toward a better technique in concrete construction generally; its fundamental justification is in offering better concrete, and not in respect to cost or convenience, although both are contributing factors to its rapidly growing favor. All ready-mixed operations should have the idea of "Better Concrete" as their objective. A prominent

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Paper read before Fourteenth Annual Convention of the National Crushed Stone Association, St. Louis, Mo., January 19-22, 1931.

concrete engineer recently remarked with reference to the ready-mixed industry: "I believe the ultimate extent of its development is entirely dependent upon the production of quality concrete." This improvement in quality results from the use of designed mixes recognizing the characteristics of the aggregates, by accurate proportioning, by automatic and positive measurement of water, by assurance of full mixing time, and through adequate inspection and testing. The supervision and testing should be complete from the materials through to the concrete as delivered; this work should be in competent hands whether handled within the organization of the ready-mixed company or by an outside laboratory who are retained for the purpose.

High-Quality Concrete for Small Contracts

Each of these features of improvement over the method of job-mixing could be discussed at length if time permitted. None is such that it could not be incorporated in the contractor's customary system of mixing at-the-job if he cared to adopt such details; but combined, they are prohibitive in expense except on very large work. Thus, a well-operated ready-mixed service offers the owner of the structure a guarantee that the quality of the concrete is superior to what was formerly thought satisfactory.

The Park Avenue ready-mixed concrete plant takes advantage of its hillside location. Cement and aggregates are hauled in at the higher elevation back of the structure

This aspect of "better quality" in ready-mixed concrete represents an extra ingredient for which the industry has not yet been able to collect in general. But as the owners and supervisors of important urban construction come to recognize the possibilities of such higher quality, there then may be expected a forceful demand for ready-mixed concrete or its equivalent. As this prospect is realized by most thoughtful producers of ready-mixed, it behooves each operator to see that his business is placed and maintained on a high level for both product and service. This consideration also requires that specifications shall be met scrupulously, even though the producer realizes that he is delivering greater strength and density and aging ability in his 1:2:4 mix than would be furnished by a 1:2:4 mixed by the contractor on the job.

A Specialty Business

Carrying out such an operation requires a specialized organization in both production and sales. Usually, the aggregate producer or the material dealer has little occasion to be versed in the finer points of concrete technique, especially as concrete is only one of the many fields to which he sells. But the ready-mixed does demand the highest and most up-to-date technique. The business might be classified as a combination of manufacturing and jobbing; manufacturing because the properties of the product as delivered differ from those of the materials as received, although the "spread" between cost and selling price at the plant is not nearly as wide as customary with most manufacturing. Furthermore, there is required a co-operation between the concrete producer and the contractor, in order that the concrete may arrive on the job at the time and in the condition required, which is far closer than is ever thought of in connection with the usual material or manufacturing business.

The selling problem in this field is similar to that of any new specialty. There is required considerable educational and unproductive effort which must continue for years, or until this new building material is firmly established. Such effort differs widely from the distribution and jobbing of a staple line. Although a large part of the present appeal in ready-mixed concrete is convenience, it is to be expected that the ultimate appeal will be that of "better concrete." Thus, along with effort for immediate sales, the producer must develop confidence in the superiority of his product and the integrity of his organization.

Ability to Deliver When Wanted

Although service is a much over-used term, it is the item of paramount importance in the ready-mixed business. In this field service means not only having a quality and guaranteed product to offer, but it includes ability to deliver when, as fast, and for as long or short a time as the customer may want, and in the manner which is most convenient for the customer to handle. Ability to deliver is as important here as in the electric light business; and we all know how vital it is to have full voltage at the switch when we turn on a light or a motor.

Two features of the ready-mixed business stand out prominently as compared to the average business in what might be considered related fields; (1) there is a relatively heavy investment in equipment, and (2) there is a surprisingly low ratio in most instances, between the average and maximum output.

Heavy Investment Necessary

The size of the investment required for a ready-mixed operation has frequently been misunderstood and underestimated. Of course, if the truck equipment is not owned by the operator, the operator's investment is minimized, but this merely transfers a portion of the total investment to others; in only a few locations has such arrangement been made and its advisability may be questioned, as it is doubtful if hired trucks can give as good delivery service as could the operators' own equipment. Or, if ready-mixed is added as a department in an established material business, the necessary added investment may be principally for trucks, as the existing unloading and storage facilities might be adequate; but then such existing investment could be considered proportioned between the dry and the wet business.

For an independent, self-contained, ready-mixed operation, the total investment for plant and trucks commonly represents from $3.00 to $5.00 per cubic yard of concrete delivered annually; it may run even higher under particular circumstances. This means that with typical delivered prices on concrete of from $6.00 to $9.00 per cubic yard, in only exceptionally favorable situations will the annual turnover be as high as $2.00 per $1.00 invested. This in turn points to the necessity of a large volume of business, handled economically, for success.

Big Variation in Demand

One factor contributing to this relation of large investment for business done is the irregularity of demand for concrete. This relation is sometimes described as "low load factor." The uncontrollable variation in orders from day to day, the necessity of being able to deliver immediately on all orders, large or small, and the influence of the weather, especially the interference of winter with many classes of construction in a large portion of the country, all mean large idle equipment time. In one representative operation with which we are familiar, the average daily output over last year was only 31 per cent of the maximum day's output. Such relation is fairly typical, although the percentage is probably much lower in many instances.

In this respect, the ready-mixed business is much like a public utility such as a street railway or an electric light company, in that the service cannot be stored but must be rendered when wanted. But there is still a distinct difference which makes the ready-mixed operation particularly difficult in that there is no opportunity for overloading, even for a brief period, as with a street car or an electric line, because the truck load cannot be increased beyond cubical capacity.

Characteristics for Success

Although this business is still young, the features we have discussed point toward certain definite characteristics of a successful operation. First, the business is fundamentally that of manufacturing a building material, but is unique because the product is perishable within an hour or two, and each delivery is made-to-order, frequently on very short notice. Second, the operation is a specialty, demanding technical supervision and specialized selling. Third, the investment for a proper type of service is very substantial, which means that irresponsible or fly-by-night operators should be discouraged. They will bring only grief to themselves as well as others. And, fourth, like a public utility, it is very desirable to have in each metropolitan district at least one large operator, as he can meet the diversity of demand more efficiently than a number of smaller operators having even a greater amount of total equipment.

But the full recognition and application of these characteristics is hardly to be expected so soon. The ready-mixed concrete business has gone through and will continue to go through many transitions before becoming standardized. While working out its destiny, we believe that the chief justification for the present use and expected expansion is that ready-mixed operation has pointed the way toward providing better concrete for the ordinary construction job in our larger cities.

Regional and District Meetings of the A. S. T. M.

The following regional and district meetings of the American Society for Testing Materials are to be held in the month of March:

New York District Meeting, March 5.—The members in the New York District are planning to hold a meeting on the evening of March 5 at which the limitations of the present knowledge of non-ferrous metals, cement and concrete, and electrical materials will be discussed.

Detroit Meeting.—The members in the Detroit District are planning a meeting to be held early in March. The exact nature of the program has not as yet been developed.

Pittsburgh Regional Meeting March 18.—A regional meeting of the Society is to be held in Pittsburgh on March 18, at which a number of subjects are to be discussed.

Reinforcing Manufacturers to Hear Two Chicago Engineers on Concrete

Addresses by two Chicago consulting engineers at the second morning's session of the Concrete Reinforcing Steel Institute, meeting March 16 to 18 at the Edgewater Gulf Hotel, Biloxi, Mississippi, will have to do particularly with concrete.

Frank E. Brown will talk on "Tall, Reinforced Concrete Buildings," and Clifford Older will tell about "Reinforcing Steel in Concrete Pavements."

Other addresses at this seventh annual convention will deal with economic factors and reinforcing manufacturers' problems.

Burial Vault Makers to Meet at Columbus

The annual meeting of the National Concrete Burial Vault Association will be held May 20 and 21 at the Neil House, Columbus, Ohio.

Coming Conventions

March 16-18—Concrete Reinforcing Steel Institute, seventh annual meeting. Edgewater Gulf Hotel, Biloxi, Mississippi.

April 21-24—Building Officials' Conference of America, seventeenth annual meeting. Toronto, Ontario, Canada.

April 27-30—National Terrazzo and Mosaic Association, annual convention. Biltmore Hotel, Atlanta, Georgia.

May 12-16—National Fire Protection Association, annual meeting. Toronto, Ontario, Canada.

May 20-21—National Concrete Burial Vault Association, annual meeting. Neil House, Columbus, Ohio.

June 3-4—National Lime Association, thirteenth annual convention. White Sulphur Springs, West Virginia.

June 22-26—American Society for Testing Materials, annual meeting. Stevens Hotel, Chicago, Illinois.

Media Plant Pioneers in Manufacture of Light-Walled Units

Large Air Space Units Successfully Made—New Design Totals Two-Thirds of Year's Sales—Same Machinery Produces Both Light and Heavy-Walled Units

By J. J. BUZZELL

MUCH has been said and done in the past about concrete building units made of light-weight material. Many of these, however, have been of the old style "standard" block design with heavy walls. Very few had more than 40 per cent air space and rarely more than 45 per cent. There has been a need for a new design with walls so light that heavy aggregates can be used without sacrifice of economy of materials and handling.[1]

The writer believes that the very first to make the advance step in this direction was the Media Concrete Products Company, Incorporated, of Media, Pennsylvania.

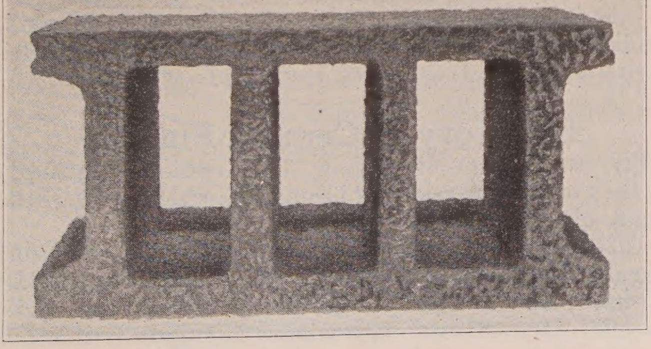
The six-a-minute Besser machine makes both light-wall and "standard" units

Standardize on 50 Per Cent Air Space

In addition to its production of old style standard block, this firm has been successful in developing a standard size 7¾ by 7¾ by 15¾ and 7¾ by 11¾ by 15¾-in. light-walled unit. This unit has all the advantages of the old style massive unit and many more. Due to a sharp flare at the top ledge, it has an inch-and-a-half mortar bed. They have manufactured units as high as 62 per cent air space but have now standardized on 50 per cent as giving the most satisfactory, all-around service.

Dense Concrete of Great Strength

This new unit is manufactured in two classes. The first is one in which they use a combination of hard aggregates resulting in a dense concrete, not nailable, but very rugged and most suitable for underground work. The 7¾ by 7¾ by 15¾-in. size weighs 36 lbs., and the 7¾ by 11¾ by 15¾-in. size weighs 45 lbs. The other type of light-walled unit is of their own origin. In this second type they have developed a peculiar combination of materials, the effect of which is to give extreme lightness of weight and free nailability with a slight crooking



The 8-in. light-walled unit

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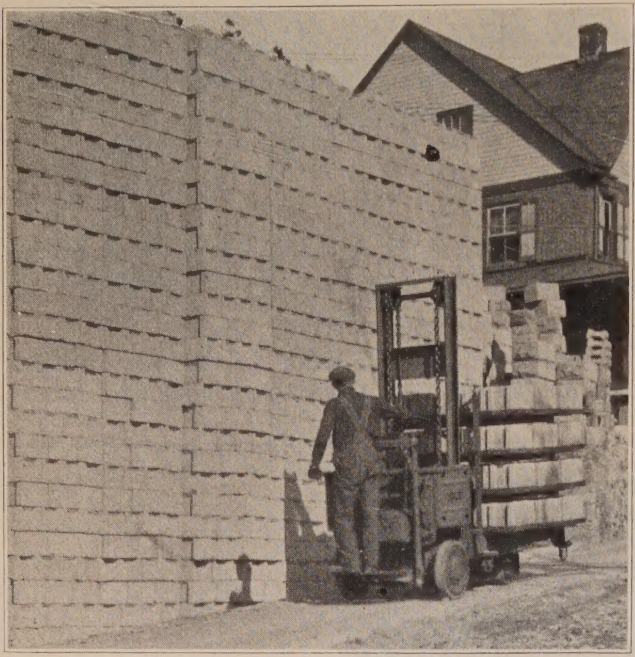
[1] November, 1930, issue of CONCRETE, pages 20-22.

of the nail, providing great holding power. The combined elements of new design and the new combination of aggregates are unique. The 7¾ by 7¾ by 15¾-in. size weighs 30 lbs. and the 7¾ by 11¾ by 15¾-in. weighs 38 lbs. The new tile units have found great favor among leading architects and have amounted to 67 per cent of the sales of the company.



High storage piles placed with high-lift truck save yard space

Plant Equipment and Facilities

The equipment used to manufacture their products is a Besser senior stripper and 25-ft. mixer. They use only the one size plain pallet to make all the various size units that are made on the machine.

Air-tight steam enclosure for thawing out frozen aggregates in freight cars before unloading

Two important siding features of the plant are the air-tight steam enclosures for thawing out cars of frozen aggregates and a large block storage area at car level along the siding, so that cars can be loaded by rolling the building units right into the cars from stock-piles.

Aggregates Heated in Storage Bins

The plant has overhead storage for 500 tons of aggregates divided in nine separate covered bins equipped with steam heating facilities to warm aggregates during winter manufacture. The mixing floor is directly beneath the overhead bins and mixer hoppers are fed by an 18-in. cross conveyor which can be fed from any bin desired. The manufacturing machines are located directly under the mixers on a lower floor so that a continuous gravity scheme is maintained from the raw aggregate to the finished product. Included in the facilities are a machine and blacksmith shop as well as compressed air equipment.

High-Lift Truck Piles Units in 16 Courses

The arrangement of racks around the machines is such as to allow continuous machine operation, and movement is provided through the use of an electric industrial track. A high-lift Yale-Towne electric truck unit is used in this capacity and double-decks the racks in the steam rooms, of which there are five, having a storage capacity for 7,000 blocks. At the stock-piles, this unit sets the racks from the steam rooms on top of the pile eight courses high, which have been stacked from the ground, thus giving a 16-course storage pile at as low a cost as an eight. This high piling is not only an economy of space but greatly facilitates loading.

Personnel

The board of directors of the Media Concrete Products Company is composed of C. Frank Williamson, president of the company; S. W. Williamson, treasurer, and Sterling Williamson, secretary. S. W. Williamson is general manager, and executive head. Due to the construction inactivity in 1930, it was possible for the manager to direct production and to handle the direct sales and credits. In this work he was assisted by John Albright, who superintends the plant, and Lane A. Davis, who takes care of the books and office.

New Books and Pamphlets

Experiments with Cement Mortar

VERSUCHE UBER DAS VERHALTEN VON ZEMENTMORTEL IN HEISSEM WASSER (Experiments with the Behavior of Cement Mortar in Hot Water) is the title of a 26-page paper-covered pamphlet (7½ by 10½ inches) published by Wilhelm Ernst & Sohn, Berlin. Price 4.30 marks.

This pamphlet contains the results of a series of tests conducted during 1928 and 1929 in the materials testing laboratory at the Technischen Hochschule at Stuttgart.

Directory of Cement Plants

PIT AND QUARRY HANDBOOK, 1931 edition. Published by the Complete Service Publishing Co., Chicago, Ill. 818 pages, 8½ by 11 in.

This handbook contains a directory of American cement manufacturing plants, including the location of individual mills, names and office addresses of officers, and other essential data. Similar information is supplied with respect to plants producing gypsum, lime, sand, gravel and crushed stone.

Vibrated Concrete Coating Protects Underground Pipe Lines

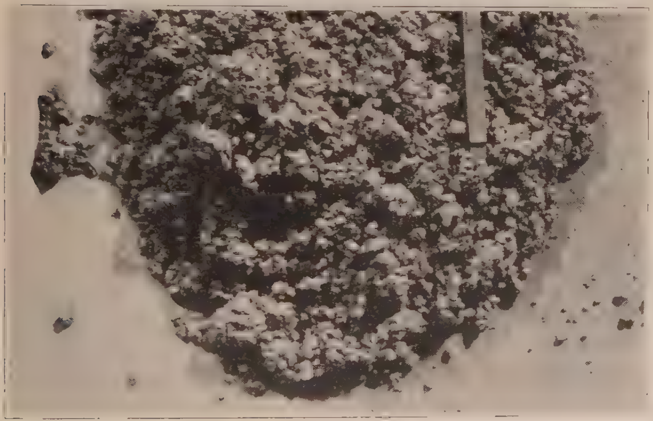
Find Vibrating Practical and Accurate Way of Placing Concrete in Thin Reinforced Layer Around Pipe—Low Water-Cement Ratio Necessary

A NEW use for concrete of the highest quality, placed by a vibrating method, has been developed in the form of protective coverings for pipe lines.

The need for a permanent covering for the vast mileage of underground pipes serving as oil or gas pipe lines, water supply lines, and similar uses, suggests at once a great potential field in which construction companies may specialize. The reconditioning of existing pipe lines that have deteriorated offers an even larger opportunity than the covering of new lines.

Kind of Concrete Required

The first requirement of a concrete pipe coating is that a dense concrete having a low water-cement ratio must be used. For economy, as well as for reasons of quality, it is desirable that both fine and coarse aggregate be used in the concrete mixture. The coarse aggregate must of necessity be confined to the smaller sizes, somewhat larger than normally found in sand. Mortars consisting only of cement and sand require a greater amount of water to produce the proper workability or placeability. Such increase in water content naturally results in lower strength and increased workability.

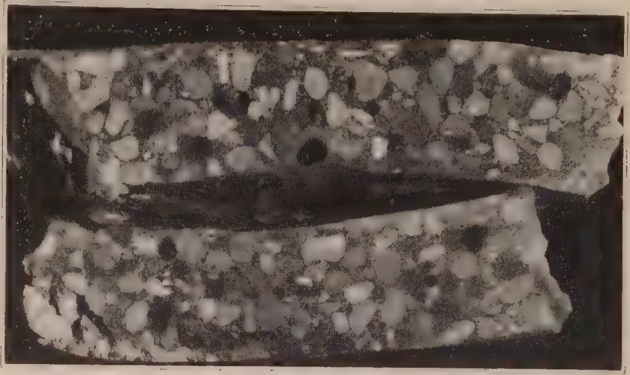


This mixture of 1 part of cement, 1½ parts of sand, and 3 parts of pea gravel, with 4¾ gallons of water to the sack of cement, produced concrete that appeared too dry to be workable, but it went into place readily under the influence of an electrically operated vibrator

Methods and Mixtures Tested in Laboratory

Experiments conducted on a large scale have been made in the laboratory of the Portland Cement Association for the purpose of developing proper mixtures and methods of coating pipes with a high quality of concrete.

First of all, a study was made of a previous series of tests begun in 1921, when 2,000 concrete cylinders 10 inches in diameter and 24 inches long were placed in sulphate soils and waters in Colorado and South Dakota, and examined at intervals later. In these locations the winter weather conditions added to the severity of the exposure. After 7 years of exposure, specimens made with a water-cement ratio of 5 gallons or less per sack of cement displayed only minor surface attacks. Those made with a water-cement ratio of higher than 8¼ gallons per sack of cement became completely disintegrated in 4 years. Water-cement ratios intermediate between the two extremes just mentioned produced proportionate results.



Sawn section of 1¼-in. pipe covering discloses the dense, compact nature of the concrete

In view of the results obtained by the 7-year tests described, it was concluded that concrete for covering underground pipe must have a water-cement ratio of not more than 5 gallons of water to the sack of cement. In fact, all concrete employed in the laboratory tests had a water-

Completed section of pipe, with 1¼-in. concrete covering

cement ratio of 4¾ gallons to the sack of cement, and this quantity is recommended.

Concrete Mixtures, Metal Forms, Reinforcement

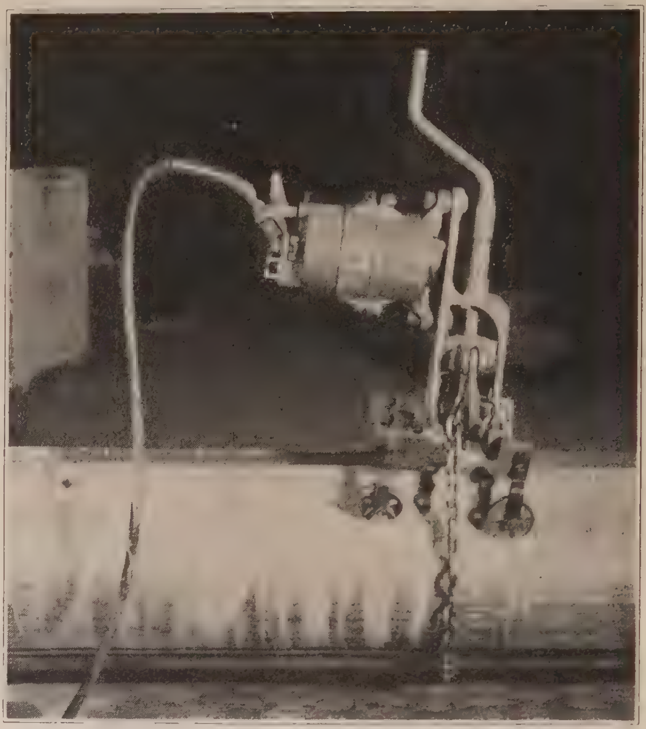
A mixture consisting of 1 part portland cement, 1½ parts well graded sand (0 to ¼ in.) and 3 parts of gravel (¼ to ⅜ in.) was made with 4¾ gallons of water per sack of cement. This mixture had the appearance of being dry and unworkable, but was readily placed in the forms and around the pipe with the use of an electrically operated vibrator supplied by the Electric Tamper and Equipment Co. of Chicago. Additional water in this mix would produce a concrete with a tendency to segregate.

This mixture was placed on a 10-ft. section of National Tube Company 8⅝-in. O. D. pipe. The concrete covering was 1¼ in. thick. The form was made of No. 14 gauge galvanized sheet metal, divided into halves with an opening at the top. The form was held off the pipe by collars at each end. American Steel & Wire Co. No. 12 welded wire fabric reinforcement, 2 in. by 6 in., was placed around the pipe and held half way between the pipe and the form. The electric vibrator was fitted to the top of the form and operated as the concrete was inserted. In spite of the unworkable appearance of the concrete it compacted readily into place and produced a dense covering with no honeycombing or segregation of materials.

A slightly modified mix having more workability, made in the proportion of 1 part cement, 1.35 parts sand, and 2.27 parts of gravel, and mixed with 4¾ gallons of water per sack of cement, produced an equally satisfactory covering. This latter mix is not as economical as the first one, since the reduction in the proportion of aggregate requires more cement for a given amount of covering. As the amount of mixing water used is the same in both mixtures, the strength and durability of the concrete should be the same.

Internal Pressure Test

The forms were removed in 24 hours and the concrete was cured under damp burlap for 14 days. The pipe was then filled with water and attached to a high pressure drum of nitrogen. Pressures up to 1,000 lb. per sq. in. were built up in 100-lb. increments, held for a time, released, and again built up. This was repeated many times, without effect except in an experimental section of the pipe where the reinforcement was omitted. In this instance a longitudinal hair-line crack developed when the pressure was between 900 and 1,000 lb. per sq. in.



The electric-driven vibrator was fitted and chained to the metal form and operated while concrete was being placed

Quantities of Material Per Mile of Pipe Line

The accompanying table gives the quantities of material required per mile of length, for different pipe sizes, where the covering consists of a 1-in. coat of small-aggregate concrete.

MATERIALS REQUIRED FOR APPLYING 1-INCH CONCRETE ENCASEMENT PER MILE OF PIPE LINE

Size of Pipe Lines Inches	Volume of Concrete Required Per Mile of Pipe Line Cu. Yds.	2 × 6 No. 13 × No. 13 Mesh Reinforcement Required Per Mile of Pipe Line		Mix 1:1½:3 W/C = 4¾ gal. per sack of cement Slump—0 Gravel—¼ in. to ⅜ in. Yield—3.99 cu. ft. conc. per sack of cement				Mix 1:1.35:2.27 W/C = 4¾ gal. per sack of cement Slump—2 in.—3 in. Gravel—¼ in. to ⅜ in. Yield—3.45 cu. ft. conc. per sack of cement			
		No. of Squares (100 Sq. Ft.) Required	Weight (Lbs.) (18½ Lbs. Per 100 Sq.Ft.)	Cement Bbls.	Water Bbls.	Sand Cu.Yd.	Gravel Cu.Yd.	Cement Bbls.	Water Bbls.	Sand Cu.Yd.	Gravel Cu.Yd.
4	23	112	2070	40	18	9	17	46	21	9	16
6	33	140	2590	55	25	12	24	64	29	13	21
8	41	168	3100	70	31	16	31	81	36	16	27
10	50	196	3625	85	38	19	38	98	44	20	33
12	59	235	4350	99	45	22	44	115	52	23	39
16	73	280	5180	123	56	27	55	142	64	28	48
20	90	336	6220	152	69	34	68	175	79	35	59
22	99	364	6740	166	75	37	74	192	87	39	65
24	107	397	7350	181	82	40	80	209	95	42	70

~ EDITORIAL ~

Slump Test Versus Flow-Table Test

MUCH discussion, entirely of a friendly nature, centered around two papers presented before the Milwaukee meeting of the American Concrete Institute, one advocating the flow-table test as the most accurate indicator of workability of concrete mixtures, and the other favoring the slump test.

The flow-table test, admittedly accurate under laboratory conditions, unfortunately introduced a variant known as the personal element. No two testing engineers are likely to obtain drops of the table of quite the same intensity, nor will the same man, when operating under conditions prevailing on a construction job, always produce the same effect.

The slump test is favored because of the simple equipment required and the simplicity of the test itself. Regardless of which method proves the more accurate in the laboratory, the slump test is likely to remain the favorite in field inspection work.

Southern States Building Concrete Highways

ONE of the most favorable indications of the vast quantities of concrete highway construction planned for 1931 comes from the South, where several states have made splendid starts on the year's program.

South Carolina, now under way with her $65,000,000 highway bond issue, has received bids on some 200 miles of concrete roads.

Louisiana, with much 1930 construction to her credit, now has a new $68,000,000 bond issue available, and has received bids on more than 200 miles additional.

Alabama is vigorously pushing her concrete highway system. Bids have been received on 263 miles of concrete road projects and five bridges.

It is of particular significance that so many southern states, with less wealth to draw from than some more favored ones, have found the means to finance complete state highway systems.

This constitutes a true indicator of what has come to be known as "Southern Progress." It is a hopeful sign of the great highway construction volume of the future—and that future is not very far away.

Back to Hand Labor—Another Fallacy

FROM many sections come reports of a wave of sentiment favoring a return to old hand-labor methods on public construction work.

In many instances pressure has been brought to bear on contractors on public work, forcing them through public opinion to use hand labor rather than machinery, so as to increase the number of men employed. One contractor in Western Massachusetts has obtained much free newspaper publicity by announcing his intention of "throwing away his steam shovels and concrete mixers" and doing all excavating and concrete mixing by hand labor. He has not made known the fact that his bids will be higher than if the usual construction equipment were used.

In a city in Kansas, where recently a contract was awarded for a water reservoir, the city council allowed $12,000 extra for the use of hand-labor methods. This extra money is just that much money wasted, for it could have been spent on street and alley paving and other work which normally utilizes a large proportion of labor.

The public officials who resort to such practices are the same public officials who will find it necessary, next winter, to figure out a painless boost in the tax rates to take care of the deficits built up.

These officials, instead of robbing Peter to pay Paul, are providing work for both Peter and Paul this year in order that both of them may be robbed next year, in the form of higher taxes.

Ready-Mixed Concrete Aids Winter Construction

ALTHOUGH all experienced contractors, engineers and architects know that concrete materials can be heated, and that freshly placed concrete can be kept warm in cold weather, they would be glad to avoid the trouble and inconvenience involved.

Now the advent of ready-mixed concrete promises relief. At least the ready-mixed concrete plants will take over the trouble of heating the materials. Experience has shown that trucks can deliver warm ready-mixed concrete the longest distance that is practicable, on days as cold as 20 degrees below zero, with a maximum heat loss of 20 degrees.

With warm, ready-to-place concrete coming to the winter construction job, the contractor has only to cover it and keep it warm. He escapes the necessity and expense of handling and heating large piles of aggregates on the job. At the central mixing plant, if it has a well-designed heating system, the heating of aggregates and mixing water is a simple, routine matter.

As the central mixing plant becomes more widely and firmly established in the large centers, and gradually invades other localities, concreting operations will become almost as common in winter as in summer, and only a little more troublesome.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Clays as Admixtures in Concrete

AN investigation of the value of clay as an admixture in concrete has been under way for some months at the United States Bureau of Standards, at Washington.

Comparisons are being made at several ages between the compressive strength, absorption, resistance to freezing and thawing, and permeability to water under pressure, of a mixture of concrete without an admixture, another in which clay to the amount of 10 per cent of the volume of the cement replaced that amount of cement, and a third in which clay was added to the amount of 7½ per cent of the volume of the sand.

Three different brands of cement and three different clays were employed in the tests. Both the cements and the clays were selected to cover a wide range in their plastic properties.

The results thus far obtained have not shown a marked difference between the compressive strengths of the concrete without an admixture and that in which clay had replaced 10 per cent of the volume of cement. The use of clay to the amount of 7½ per cent of the volume of sand has resulted in a small, but consistent, increase in strength.

The water absorption of the concretes containing clay were slightly greater than those without an admixture, but the difference between the two was too small to be of positive significance. Admixtures of clay seemed to reduce the permeability at the earlier ages, but at the age of one year there was no marked difference in permeability between the concretes with and without clay.

Concrete-Making Properties of Sand and Gravel

THE program of study and investigation being conducted by the National Sand and Gravel Association includes the continuation of investigations previously begun on the concrete-making properties of sand and gravel aggregates, and the beginning of additional studies. Following are some of the items in the program:

1. Effect of characteristics (other than grading) of coarse aggregates on the strength of concrete. This includes studies of mineral composition, surface texture, strength and shape of the particles.
2. Methods for testing the durability of aggregates and concrete.
3. Correlation of tests of sand with their concrete-making properties.
4. Studies of size and grading of aggregates, with particular reference to methods for proportioning fine and coarse sizes for concrete.

Bureau of Standards Investigating High-Early-Strength Cements

THE U. S. Bureau of Standards, at Washington, is continuing its investigation of the properties of high-early-strength portland cements, begun in November, 1929.

The tests include the making and testing of a number of 6 by 12-inch concrete cylinders, mixed in the proportions of 1:2:4 and with 6½, 7½ and 8½ gallons of water to the sack of cement. Tests of compressive strength have been or will be made at the ages of 1, 3, 7 and 28 days, and 1 and 2 years, of cylinders cured in damp-rooms. Air-cured cylinders are tested at the ages of 7 and 28 days, and at 1 and 2 years. Freezing and thawing tests also are being made.

Waterproofing Agents for Concrete

TESTS of a number of commercial products sold as waterproofers of concrete have been about completed at the United States Bureau of Standards, Washington, D. C.

These tests, which were mentioned briefly on this page in the December (1930) issue of CONCRETE, include examination of fifty integral and fifty surface-applied materials.

The integral waterproofing compounds have been incorporated in a 1:3:6 mixture of concrete. The test specimens were subjected to a water pressure of 20 lb. continuously for one year, and the amounts of water passing through the specimen per minute have been recorded at regular intervals. Concrete of the same character, but containing no waterproofing material, has been tested in the same manner, thus giving a measure of the comparative impermeability of the various materials. Strength tests were also made.

The surface-applied waterproofing materials were applied to 3 by 6-inch cylinders made from a 1:2:4 mixture, after the cylinders had been cured for 28 days and then dried to constant weight. After the surface coatings were applied the cylinders were totally immersed in water, and were then weighed at regular intervals during the year. The weights of water absorbed were recorded.

A complete report on these tests is now being prepared for publication.

Tentative Federal Specifications for Cast Stone

A TENTATIVE specification for cast stone has been prepared by the Federal Specifications Board of the United States Bureau of Standards, based on the results of tests made by the Bureau.

The specifications require a minimum compressive strength of 4,000 lb. per sq. in. The absorption of water after a 48-hour test shall be less than 10 per cent, by weight. After the 5-hour boiling test the absorption of water shall be less than 12 per cent, by weight.

Several interesting specimens of cast stone were encountered during the tests. One had a crushing strength of 21,700 lb. per sq. in. Freezing and thawing tests were thoroughly satisfactory.

Specifications issued by the Federal Specifications Board are used as standard purchase specifications covering commercial commodities bought by the various departments and independent bureaus of the federal government.

Profitable Manufacture of Concrete Building Units

Layout of Plant and Preliminary Block Plan—Determining Approximate Space Requirements of Materials—Provision for Equipment—Stock-Piling Arrangement—Manufacturing Building

IV—Plant Layout

By FRED A. SAGER
Consulting Industrial Engineer

Having previously outlined the business and scheduled the output of the average size plant, Mr. Sager now takes up the vital matter of plant layout.

The concrete products plant is a manufacturing enterprise, Mr. Sager has said, and it is only by applying established industrial methods that the greatest success can be attained. It is on this basis that he is making an analysis of every phase of the business for the readers of "Concrete."

If the typical products plant could invest a considerable sum and secure the benefit of real consulting service, it could obtain no better help from a more experienced engineer than that given by Mr. Sager in this article, in those in the December, January, and February issues, and in those to come.—The Editors.

USING as the basis the information given in Table III,[1] as to production and stock of finished product carried, the layout of a suitable plant and a preliminary block plan will now be considered.

Table III requires a production of 30,000 units per month and stock storage for the average minimum stock of 70,000 units, with a maximum stock of 119,012 units to be stored. The segregation of these stocks into the main items to be controlled is as follows:

	Average Minimum Stock		Maximum Stock	
	Number	Equivalent Units	Number	Equivalent Units
8-in. Plain	25,000	25,000	47,988	47,988
10-in. Plain	4,000	5,000	1,722	2,152
12-in. Plain	10,000	15,000	22,500	33,750
8-in. Corners	3,000	3,000	3,532	3,532
Brick	30,000	3,000	45,800	4,580
4-in. Plain	15,000	7,500	23,094	11,547
All Others	11,500	11,500	15,463	15,463
Total in 8-in. Units		70,000		119,012

Space Requirements

It should be noted that the final block plan can be made only after the detailed layout of each part of the plant has been made. But if an approximate idea of the space requirements of each part of the manufacturing process is determined, a general plan can be drawn up, which will affect the operating features of the various processes in the plant. The entire study can be carried on at one time, but generally time is saved by following the above procedure.

In working out a preliminary block plan for a given site, it is often of advantage to make up outline sketches of the various parts of the plant, such as raw material storage, manufacturing plant, kilns, unit sections of the type of finished product, storage yard proposed, etc., and cut these out on separate pieces of paper, which, drawn to the same scale as the property site, can then be arranged in various combinations to study the advantages of different locations. For preliminary studies this method is much faster than that of making up complete drawings for each layout considered.

Characteristics of Plan

The use of the preliminary block plan is very desirable, since irrespective of the type of machinery used in the manufacturing plant, or of the method of handling and storing the raw materials and finished product, there is a definite plan to be worked out for the project as a whole. For example, in the preliminary block plan of Diagram 5, provision is made for a plant site located on an inside lot fronting on a paved street with railroad siding at the rear. In this layout two fundamental characteristics are provided for, viz., a plant arranged for future extension, and, one-direction flow lines for materials through the plant.

A layout with much cutting of inter-plant material flow lines is always disadvantageous in operation, and a layout on the unit idea is desirable from the standpoint of future extension. If these conditions can be realized in a layout that can be efficiently operated with the business immediately in hand, such a layout should be adopted.

On this method of procedure it is first necessary to determine the approximate space requirements for the various processes involved. As to cinders, the output of 30,000 units per month will require 900,000 lbs. of cinders per month, based on the use of 30 lbs. of cinders as received per unit, an 8 by 8 by 16-in. block. Perhaps the records of aggregates in most plants are kept in cubic yards. This unit could as well be used for the present purpose, but the record of cinders on hand and used in manufacture works in well with material received in carload lots, on which the weights are known.

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[1] February issue, CONCRETE, pp. 28-29.

Regulating Receipt of Aggregates

Over a period of two or three years it has been found that but slight adjustment is necessary to secure proper charges of raw material to manufactured units. Based on an average of 25 working days per month, the use of cinders per day is 36,000 lbs., which corresponds to the manufacture of 1,200 units per day. Carload shipments of cinders will run from 90,000 lbs. to 110,000 and occasionally to over 120,000 lbs., and may be averaged at slightly over 100,000 lbs. The above requirement is then about 2 cars per week, or for the thirteen weeks in a quarter year, 26 cars or 2,600,000 lbs.; which, with the usual overrun above noted, will take care of the 2,700,000 lbs. estimated to be used in a three-month period.

The order can be placed for such shipment and variations from the estimated average can be handled by ordering an extra car or cancelling the shipment of a car, as the case may be. With such a schedule of shipment of two cars per week, cinder storage for three or four cars should be ample. For storage of four cars or 400,000 lbs. at about 1,500 lbs. per cu. yd. or 55½ lbs. per cu. ft., 7,200 cu. ft. will be required.

Storage Facilities

Since the material has to be handled to the screens and crusher, elevating equipment will be provided and bins 20 ft. in height requiring 360 sq. ft. of ground area can be assumed. Such storage capacity will allow average minimum stock for over six days' run to be carried, which should be ample for a small plant with an annual contract for cinders from a reliable source.

Ordinarily the bins would be practically filled on the receipt of the regular semi-weekly shipment. If the bins were less than half full they could be filled by a two-car shipment. Should overstocking occur, the use of cinders at the rate of one car in three days would result in not more than one day's demurrage charge. As a matter of fact, there is leeway enough in the storage capacity assumed, so that there should be no demurrage except in serious breakdown in plant machinery.

Use of Cement

The requirements for cement are likewise based on the production of 30,000 units per month. On the basis of 17 units a bag of cement, about 1,760 bags or 440 bbls. of cement will be required a month. With carloads ranging from 150 to 200 bbls., one carload is required for from 8 to 12 days' operation and storage for 2 carloads, or from 1,200 to 1,600 bags, will be taken. With allowance of 1¼ cu. ft. per bag for storage space, 1,200 bags will require 1,500 cu. ft. of space and if piled 5 ft. high this will take 300 sq. ft. of ground. Substantial addition to this capacity can be had by higher piling, if storage be on concrete ground floor. If cement be received from local yard by truck delivery, storage space may be less.

Provision should be made for elevator and crusher adjacent to the cinder storage and for the boiler near the coal storage, for which an area 20 by 20 ft. or 400 sq. ft. should suffice.

All of the above facilities, with possible exception of the boiler, should be immediately adjacent to the railroad siding, and as estimated, will require a total of 1,400 sq. ft., or a strip 20 by 70 ft. alongside the siding. On the block plan this area is shown as 60 ft. long and some additional space is included in the area for block manufacture to balance this deficit.

Equipment and Building

In the manufacturing plant provision must be made for one or two standard block machines, a brick machine, possibly a Multiplex hand-operated machine, mixer, motors and storage for pallets and miscellaneous equipment. This should probably be housed in a building 30 by 50 ft. or 1,500 sq. ft. in area. In the preliminary block plan this area is taken as 30 ft. in the direction of the depth of the lot and is made 60 ft. crosswise on the lot, to provide for the shortage in the storage space provided for cement and to square up the building plan.

For kiln space, with the output of 1,200 units per day, four kilns each of 600 unit capacity are provided, the total area for kilns being 32 by 36 ft. or 1,152 sq. ft. It is noted that the kiln space as laid out occupies too much length and not enough width of the lot. Every foot of the length of 36 ft. takes off one foot of the 132-ft. width available for storage of finished product and the detailed study may lead to another arrangement of this area.

Method of Stock-Piling

For storage of finished products, the plan of two stockpiles each 16 ft. wide, 12 units end to end, separated by a driveway 12 ft. wide, with a concrete runway in the middle, has been shown. With blocks piled 11 blocks high or 132 units per tier, the capacity per foot of pile is 198 units, and 100 ft. of pile would take 19,800 units. To allow for loose piling, the length of such pile is increased to 105 ft. and six such piles are shown in Diagram 5 as the primary storage area, which has capacity for storage of 118,800 units.

From the records of units in stock, shown above, the average minimum stock is 70,000 units and the maximum stock is 119,012 units. The latter amount slightly overruns the primary storage area, an event for which reasonable provision must always be made. The two 16-ft. piles with the 12-ft. roadway between, occupy a width of 44 ft., and the three sets, a width of 132 ft. This, with the length of 105 ft., gives the area of 13,860 sq. ft. in primary storage.

Summary of Areas

Space will be required on the property for truck roadways, garage if needed, and the necessary plaza or turning around space adjacent to the manufacturing building. Some space near the manufacturing plant will be needed for access and minor miscellaneous storage. For the purpose of the following summary of areas, the area from the upper line of the plant building to the lower property line and from the right-hand line of the kilns to the railroad siding has been included in one area designated "Manufacturing."

This area is 75 ft. by 82 ft., or 6,150 sq. ft. The total area of the lot, 150 by 250 ft., or 37,500 sq. ft., is divided as follows:

	Feet	Square Feet
Railroad siding	16 by 150	2,400
Manufacturing	82 by 75	6,150
Garage	28 by 23	644
Block storage	105 by 132	13,860
Roadways	470 by 18	8,460
Additional block storage for max. stock		1,024
Open space adjacent to plant		4,962
Total		37,500

The capacity of the additional block storage for maximum stock conditions, located at the right of the primary stock storage, if figured at 8.6 units per sq. ft., is 9,700 units. This, added to the primary storage of 118,800, gives a total of 128,500 units, if space is fully occupied. Practically, this capacity can never be realized as space will occur between piles of different items, as shown in the upper stock-pile in Diagram 5, where the eleven items of small production are stored. Also with deliveries moving out of stock and manufactured units moving in, there must be some gaps in the stock-piles even in times of maximum stock.

Stock Areas

In the diagram the fine cross-hatching indicates the areas occupied by the average minimum stock of 70,000 units. The heavy full lines enclose the primary storage area and the additional storage areas are enclosed in the dotted lines. The additional area occupied at time of maximum stock is shown by the double-spaced cross-hatching. It is noted that when stocks are within the primary stock area, there is ample space for the operation of delivery trucks. The clearance lines for a 21-ft. overall truck with 8-ft. body width and 13-ft. 6-in. wheelbase, is shown on the diagram, indicating that truck operation at time of maximum storage is possible, though close.

The roadway area tabulated above includes the 18-ft. strip from the street to the garage and an 18-ft. strip along each end of the stock-piles.

The essentials of the preliminary block plan in Diagram 5 are, as stated above, to provide for direct flow of all materials through the property and to provide for future expansion by adding more property at the lower side of the diagram, the unit plant idea being included in the layout to make such extension feasible.

It is readily seen that the unit idea is not perfectly represented in this layout and it is quite usual that compromises have to be made in this respect. In this case the width of the storage area is too great for the width of the manufacturing area to repeat this unit many times and still hold the proper relation between the various processes.

If the width of the storage area were reduced to two

(Continued on Page 32)

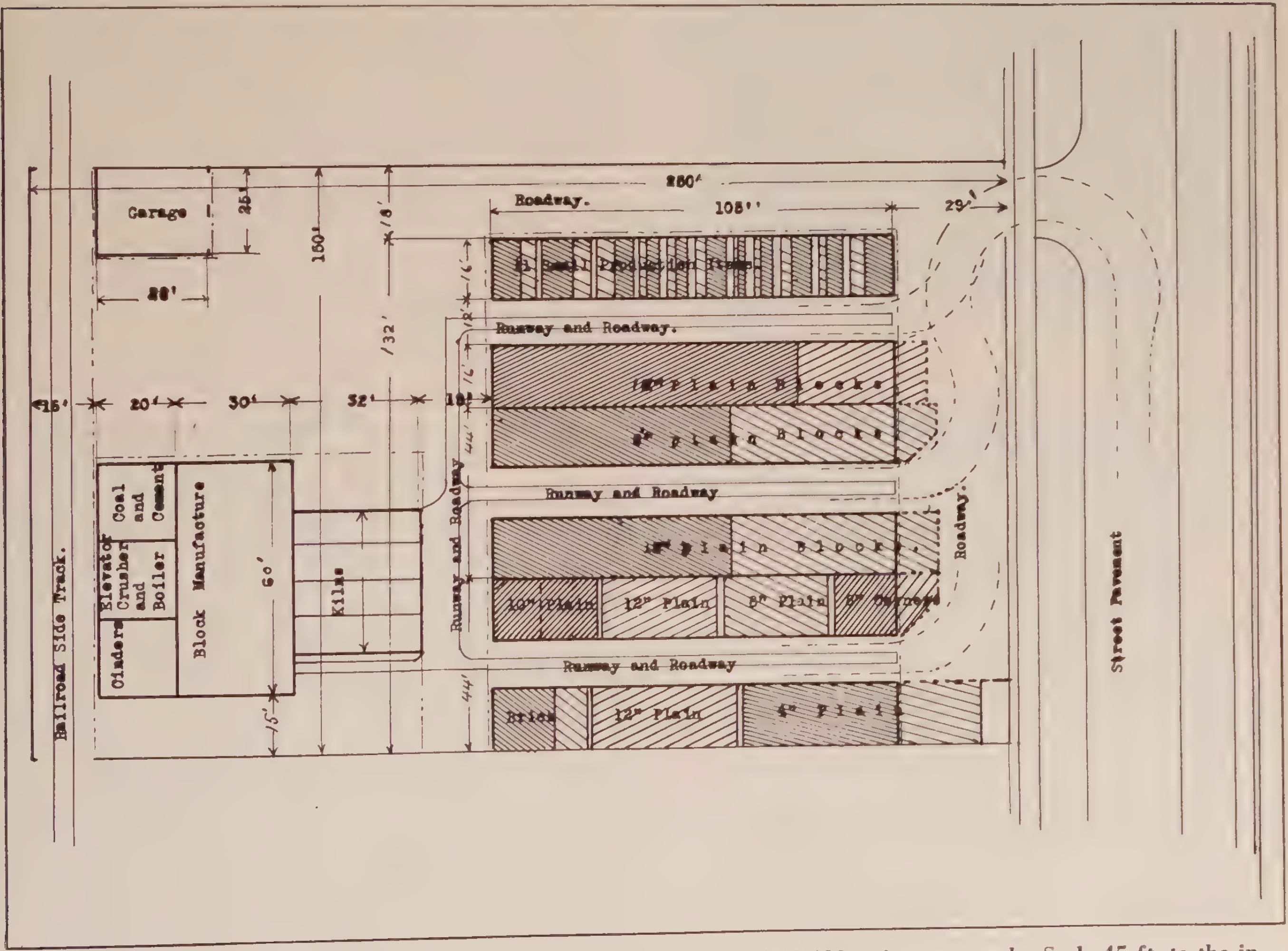


Diagram 5. Preliminary plan for products plant having capacity of 30,000 units per month. Scale 45 ft. to the in.

Chicago and North Western Instructs Inspectors of Concrete Work

List of References and Blank Forms Required—Making, Storing, Marking and Shipping Test Specimens—Field Testing Equipment Supplied by Contractor

By O. F. DALSTROM
Engineer of Bridges, Chicago & North Western
Railway, Chicago, Illinois

This is the second of a series of three articles telling how the bridge department of the Chicago and North Western Railway succeeded in controlling and improving the quality of concrete by establishing the water-cement ratio method of control.

Part of the general plan involved the issuance of instructions to the railway company's engineering and inspection forces. These instructions are given in this issue.—The Editors.

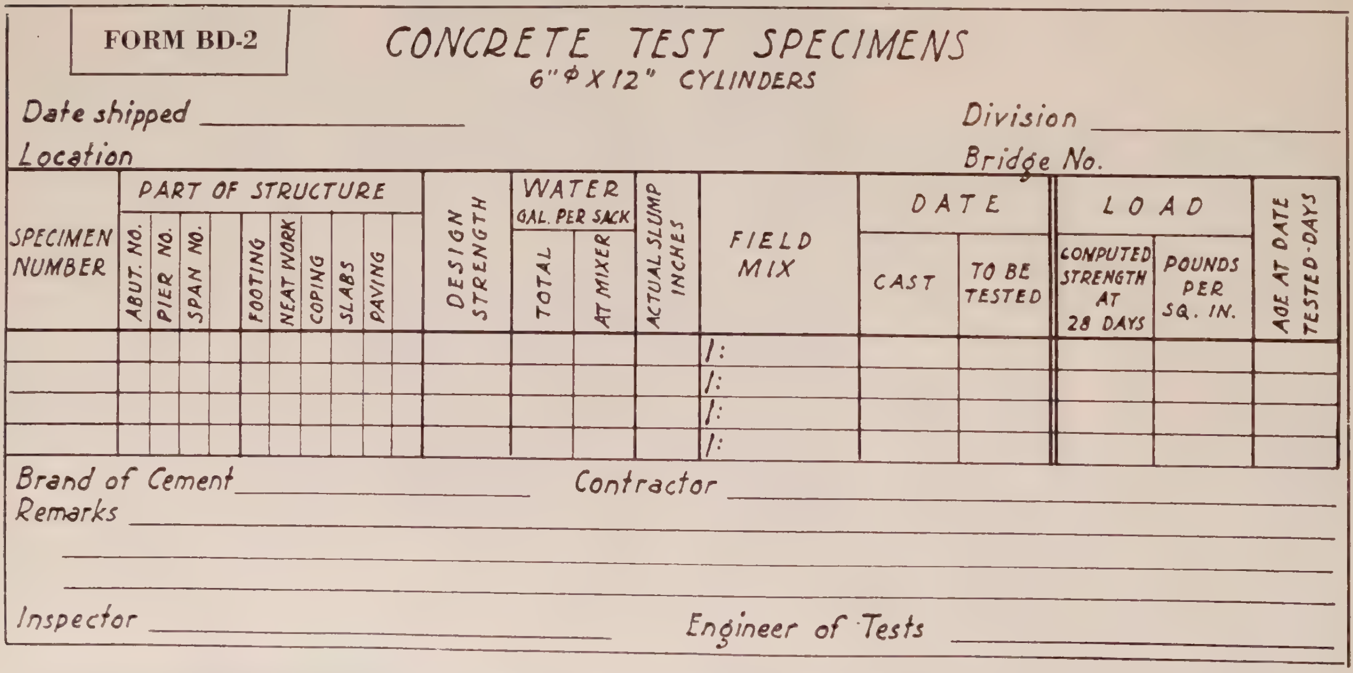
As a part of the plan described in CONCRETE last month,[1] whereby the bridge department of the Chicago & North Western Railway inaugurated and established field methods of controlling the quality of concrete, all men in the railway company's engineering and inspection forces were required to attend a two-day course of instruction. This course of instruction, given by the Railways Bureau of the Portland Cement Association, was first undertaken early in 1928 and has been repeated in the early spring of each year since then. Out of fairness to the company's engineers and inspectors, it should be said that the opportunity to attend these instruction sessions has been eagerly accepted by all.

Written Instructions Issued

In order to help the railway company's concrete inspectors fix the essentials in their minds and define clearly their duties under the new order of things, they were supplied with written instructions.

Specifications, References and Blank Forms Required

The instructions first called attention to the railway company's rewritten *Specifications for Masonry*, in which the water-cement ratio method of control was made the essential feature. Special emphasis was also placed on the necessity of becoming thoroughly familiar with the new specifications and with the method of designing concrete mixtures and recording data. Next, the inspectors were directed to have the following specifications, instructions, references and blank forms in their possession:



FORM BD-2

CONCRETE TEST SPECIMENS
6"Φ X 12" CYLINDERS

Date shipped __________ Division __________
Location Bridge No.

SPECIMEN NUMBER	PART OF STRUCTURE										DESIGN STRENGTH	WATER GAL. PER SACK		ACTUAL SLUMP INCHES	FIELD MIX	DATE		LOAD		AGE AT DATE TESTED-DAYS
	ABUT. NO.	PIER NO.	SPAN NO.		FOOTING	NEAT WORK	COPING	SLABS	PAVING			TOTAL	AT MIXER			CAST	TO BE TESTED	COMPUTED STRENGTH AT 28 DAYS	POUNDS PER SQ. IN.	
															1:					
															1:					
															1:					
															1:					

Brand of Cement __________ Contractor __________
Remarks __________
Inspector __________ Engineer of Tests __________

Form BD-2, the field and laboratory report. Identical with that reproduced on page 21 of the February issue, it is repeated here for convenience

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[1] February, 1931, issue of CONCRETE, pages 19-22.

(a) C. & N. W. Railway's rewritten *Specifications for Masonry.*

(b) C. & N. W. Railway's *Instructions for Designing Concrete Mixtures.*

(c) Portland Cement Association's *Design and Control of Concrete Mixtures.*

(d) Portland Cement Association's *Colorimetric Test for Sands.*

(e) Portland Cement Association's *Specifications for Making, Placing and Curing Concrete in Cold Weather.*

(f) Supply of blank form headed *Concrete Mixture Data and Design* (Form BD-1).[2]

(g) Supply of blank form headed *Record of Concrete Test Specimens* (Form BD-2).

Contractors' Equipment

The *Instructions to Inspectors* next contained a list of equipment which contractors or railway construction crews were to have on every job involving the placing of concrete. The list was enumerated, and was identical with the *Itemized List of Field Testing Equipment* given in the first installment of this series[3] of articles.

It was the contractor's duty to carry and maintain the list of field testing equipment just mentioned, and to place this equipment at the disposal of the railway company's inspector. It was not considered necessary for the inspector to have a duplicate testing outfit, although in general the inspectors were encouraged to carry certain parts of the equipment.

Duties of Inspectors

Finally, the specific duties of inspectors of concrete work were outlined as in the following paragraphs numbered from (1) to (10):

(1) Make tests of organic impurities in aggregates. Tests should be made whenever a new supply of aggregate is brought on the job. See "Colorimetric Tests for Sands."

(2) Make tests to determine the amount of silt present in sands.

(3) Design mixtures as outlined in "Instructions for Designing Concrete Mixtures." A design should be made for each class of concrete called for on the plans, and whenever there is a change in the aggregates, or a marked change in the water content of the aggregates. One copy of the design should be sent to the engineer of bridges.

(4) Make several determinations of the amount of water carried by aggregates each day concrete is placed. A change in the amount of water carried by the sand will cause a change in the bulking of this material, which may make it necessary to redesign the mixture.

(5) Make certain that the mixer is equipped with a reliable water measuring device, and that the valves do not leak. A mixer not properly equipped must not be used. The water measuring device should be capable of measuring water accurately, and sensitive to within one-quarter gallon per bag of cement. It is of primary importance that the inspector supervise the setting of the device and watch it closely. The mixer is also required to be equipped with a timing device, which should be set to give a 1½ min. time of mixing.

(6) Make frequent slump tests as outlined in "Instructions for Designing Concrete Mixtures." Use the slump test as a guide to wheelbarrow loading and workability, but NOT as a means for control of water.

(7) Make or supervise the making of test specimens. Two specimens (for 7 and 28-day tests) are required to be made every day concrete is placed and of each class of concrete placed on that day. In order to secure uniformity, so that the results shall be comparable, the following points should be closely observed:

(a) The concrete mixture discharged from the mixer is liable to vary—that first discharged may vary from that discharged just previous to complete discharge. The sample selected should be a representative one.

(b) Stones as large as 2 or 3 inches make good concrete in a large mass, but are unsuitable in a 6 by 12-in. cylinder, and may show up a test badly. In general, the maximum size of aggregate should not be more than one-fourth of the diameter of the cylinder. Large stones should be rejected.

(c) Proper placing of concrete in the moulds and proper rodding are very important. Insufficient rodding will result in honeycombing, while excessive rodding will cause the large stones to be crowded to the bottom. Concrete should be thrown into the mould with a sugar scoop, first to one side, then to the other, instead of filling the mould indiscriminately, and pushing it around afterwards with the rod to level it off. After the mould is filled to a depth of 4 inches, it should be rodded with from 25 to 30 vigorous jabbing strokes of the rod, so that the rod nearly reaches the bottom. The rod should be directed all around the sides as well as in the center of the mass. Another 4-inch layer of concrete is then put into the mould in the same way and rodded. In this and the third layer, the rod should not enter the previous layers. The cylinder should then be filled to the top, rodded, additional material placed on top, and patted and smoothed with a trowel.

Inspection at end of day's work

(d) The cylinder should be placed on a smooth, level surface while being made, and allowed to stay there, protected from the direct rays of the sun and protected from cold in winter, until the concrete is thoroughly set, then placed in warm, wet sand for curing. Temperature is important.

(8) Mark all cylinders and keep a record of them on Form BD-2, so that they can be properly identified. It is suggested that marks consist of the bridge number, followed by the cylinder as made. The specimens intended for 7-day test should always be given odd numbers and the 28-day specimens even numbers. Thus the 13th cylinder made at bridge No. 264 would be marked 264-13, and would be the 7-day specimen. The 14th specimen, made

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[2] To be reproduced in the April issue of CONCRETE.

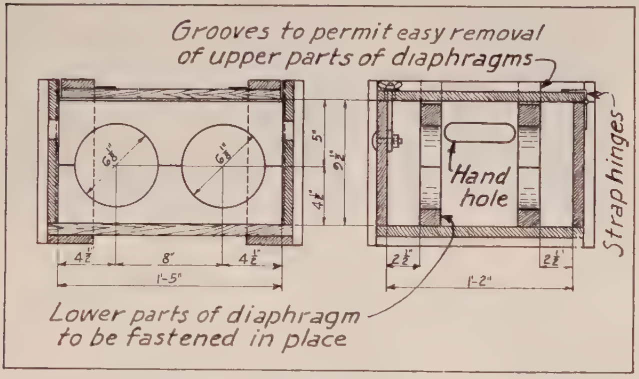
[3] February, 1931, issue of CONCRETE, page 20.

the same way, from the same batch, would be marked 264-14, and would be the 28-day specimen. The two constitute a pair, the results of which can be checked against each other. If, for any reason, it is desired to make specimens other than those required, they should be given special marks, as for example 264-1A.

Black paint seems to be the best material for marking the specimens. The marks should be painted on the sides of the cylinders, not on the end, as the paint on the end gets covered up with the capping process, or the paint prevents the capping material from sticking to the concrete. Where the specimens are moulded in metal moulds, the paint can be applied directly to the concrete after permitting the surface of the cylinder to dry slightly. Where paper moulds are used, they can be painted several days in advance of the actual making of the specimens, so that the paint will be thoroughly dry, and the marks will not be obliterated in handling the specimen. The paper moulds form a good protection for the specimen for shipment, and should be left on the concrete. The continual wetness of the concrete and packing material causes the paper mould to unwind and fall apart, however, and when off, the marks are off also. It is suggested that as a precaution, a string be tied around the cylinder, near each end, to hold the mould in place until the laboratory is ready to test the specimen.

(9) Label and ship test specimens to the engineer of tests, Chicago shops. Specimens intended for testing in seven days should be shipped three days after casting. If more convenient, the specimens intended for the 28-day test can be shipped at the same time, but in any event, the 28-day specimen should be sent in at least seven days in advance of the date of testing.

It is the contractor's duty to furnish crates or boxes for shipment of test specimens. Specimens should be so packed that the ends will not become damaged in shipment, also so that the specimens will not dry out. Wet sand, sawdust, shavings, or other material which will hold moisture should be used as a packing material. Where well built boxes are furnished, with hinged covers and lined with hair felt, as shown on Drawing No. 17978, the hair felt should be well moistened before shipment. These boxes will be returned to the job by the engineer of tests, if boxes are so labeled.


Grooves to permit easy removal of upper parts of diaphragms
6⅛"
6⅛"
5"
9½"
4¾"
Hand hole
Strap hinges
4½"
8"
4½"
1'-5"
2½"
2½"
1'-2"
Lower parts of diaphragm to be fastened in place

Details of crate for shipping test specimens. Drawing No. 17978

Five copies of Form BD-2 should be sent along with each shipment. They should be filled out completely except for the information to be supplied by the engineer of tests. A single sheet should not contain the records of cylinders with widely varying testing dates. Where there is a wide variation in testing dates, separate sheets should be made out, grouping the cylinders so that the testing dates are approximately the same. This will permit results of tests to be returned more promptly. Be sure the dates are entered properly.

In making out reports on Form BD-2, the information regarding the amount of water used and the field mix need not be the same as that determined in the design by the use of Form BD-1. It is sometimes impracticable to use the exact total amount of water called for by the specifications, but in no case should the amount be exceeded. Also, it may be impracticable to use the exact amounts of aggregate called for in the design, in which case the actual proportions of the mix used should be shown.

(10) Watch the minimum mixing time, and watch the placing of concrete in the forms to guard against segregation and the formation of laitance.

Profitable Manufacture of Concrete Building Units

(Continued from Page 29)

units 88 ft. in width, to which was added the 18-ft. roadway, or a property width of 106 ft., the balance might be better. This, however, would require a longer average haul of manufactured product from the plant to the storage piles. All these things have to be considered in working out the final layout.

Provision for Expansion

If the future expansion is to be three or four times the present development, the above suggestion might be carefully considered. If the expansion is only double the present layout, the space below the extended manufacturing area can well be used for additional storage, thus giving storage along the railroad siding.

The best that can be done with the preliminary block plan is to get a fairly definite idea of how the proposed plan of operation will work out on the given piece of property. With this in mind detailed studies can be started on the layout of the different parts of the plant.

Toronto to Welcome Fire Protection Meeting Delegates

Arrangements for the National Fire Protection Association annual meeting to be held from May 12 to 16 at Toronto, Canada, are well under way. Toronto members are planning a number of special features in addition to the usual convention program.

It is expected also that special cars will be run from New York and Chicago for the convenience of delegates from those localities.

National Cinder Products Association Convention Held

The eighth annual convention of the National Cinder Concrete Products Association was held at Atlantic City on January 21 to 23.

Included on the program were the showing of a model cinder unit plan layout, an outline of the work being done at the Bureau of Standards, and talks on sales and credits and collections.

Research Supplies the Knowledge That Sells Masonry Units

Joint Products Convention at Milwaukee Discusses Many Phases of Relation Between Research and Selling—Facts Must Be Interpreted in Understandable Language

"Research and Selling," the title of the paper which is abstracted below, and which was read by Einar Christensen, consulting engineer, before the joint annual meeting of the Concrete Masonry Association and the Wisconsin Concrete Products Association at Milwaukee, on February 23, expresses quite definitely the underlying theme which ran through most of the excellent papers presented.

For the benefit of interested readers who were not at the joint convention, others of the papers read before this notable gathering of products manufacturers will be abstracted in later issues of CONCRETE.

The program of the joint convention was printed on page 39 of the February issue. —The Editors.

USUALLY there is no direct contact between the salesman and the research engineer. As a matter of fact, they frequently don't like each other. What we always need is an interpreter who can translate the data obtained and reported by the research engineer into everyday language, without losing accuracy and without dropping the essential facts. The interpreter makes the facts understandable.

Has Served as Interpreter

When the writer was given this subject to present before this convention, it may have been because some one thought he had conducted a great amount of original research. That is not the case, for his work in the cinder unit industry has been that of translating dry and involved data into ordinary language. For example, the so-called "sulphur" in cinders deserves a lengthy treatise. Such a treatise is available for those who want all the details; but the subject is just as adequately dealt with, so far as the user of cinder concrete masonry units is concerned, in a two-page article published by the writer.

Engineer, Interpreter and Salesman All Needed

If we are really to know our product, and sell it efficiently on the basis of such knowledge, we need all three —the research engineer, the interpreter and the salesman. Likewise, the engineer and the salesman need each other, even though neither may like to admit it.

The research engineer, on his part, proceeds to look for facts. If he is an engineer without quotation marks he stops at nothing to learn the truth, even if the truth is unpleasant.

The salesman, in his turn, likes to tell the architect that the product he is selling is the very best of its kind in the market. But the trouble is that in the highly competitive field of masonry materials there are several good products beside ours. In consequence, the salesman has to know something tangible about his product if his strong and positive assertions are to be accepted. In short, he needs the information which the research engineer has built up for him, after it has been put into language which he can understand and impart to others.

What the Salesman Should Know

The salesman knows a great many things qualitatively. He knows, for example, that the concrete masonry unit he is selling is strong, that "stucco and plaster stick," that "you have no need of lying awake at night thinking about fire," and so on.

In contrast to his qualitative knowledge, the salesman does not know enough quantitatively. Not enough of our salesmen can sell a heating expert on the insulative value of their product, or convince a fire-protection specialist of the value of our product in a fire-wall. Only a few of our salesmen can sell the fire insurance expert, or (most difficult of all) the expert on acoustics.

If any one is inclined to question the foregoing assertions let him try for himself. He will soon become convinced that he does not know enough about his product.

What the Entire Industry Should Know

Of course, we should all know the truth, whether we are research engineers, interpreters, salesmen, or managers; but in addition to knowing the truth, we must know what it means in cold figures.

This is neither the time nor the place to list the lines of research to be carried forward. A few hints of what is needed—and what is being done about it—will suffice. There is the old topic of "wall behavior," for example. Concrete masonry walls have some very interesting and valuable characteristics which can not be accurately predicted from our knowledge about individual units. To know wall behavior we must proceed with a man-size research program.

Research Is Under Way

Research programs are under way. Wall strength is being studied. Fire resistance has been studied for some time; in fact one section of the concrete masonry industry last year inaugurated a thoroughgoing program to cover all phases. The cinder unit section of the industry has inaugurated its own research program in co-operation with the United States Bureau of Standards.[1]

Other research programs are either in progress or in the making, under the direction of other sections of the industry itself, by individual plants, and by the Portland Cement Association. In all that is being done, there is mutual benefit to be derived. When it comes to research, all branches and sections of the industry have much in common.

Competitors Are Lined Up

There is a real battle to be fought. Our competitors are lined up, and we can not fight them as well as we should if we are not working together. Belief in one's product is a great thing; but such belief must be supplemented by definite knowledge if a battle of this kind is to be fought to a successful conclusion.

Summarizing all this, we must have unceasing research to establish the facts in detail, then the translation of these facts into ordinary language, then the straightforward use of the translated facts as ammunition by the fighter on the firing line—the salesman.

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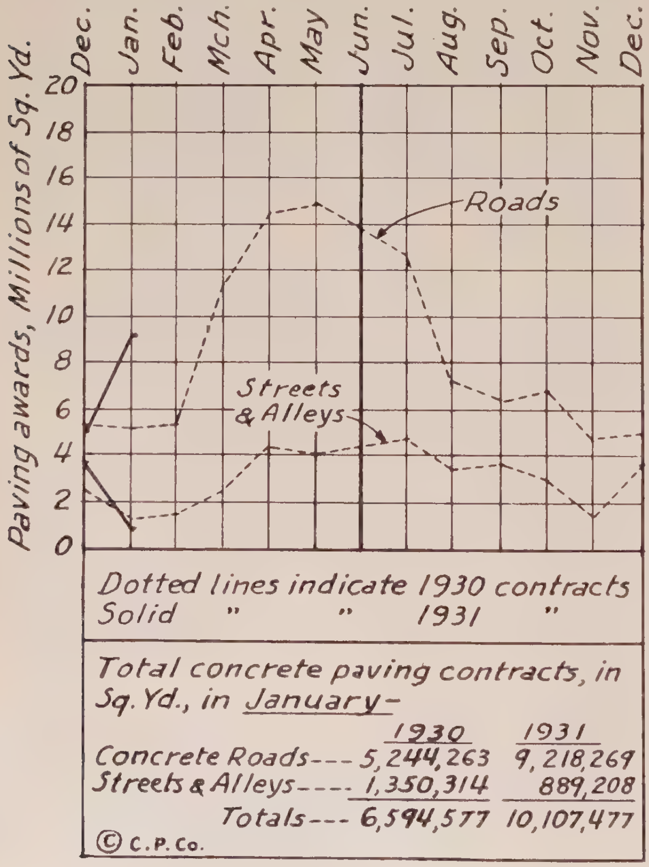
[1] See December (1930) issue of CONCRETE, page 26.

Highway Contracts Start Year with Big Increase

Paving Contracts 53 Per Cent Above January, 1930—Good Outlook for General Construction

With 9,218,269 sq. yd. of concrete highway pavement work reported by the Portland Cement Association as having been awarded in January, compared with 5,244,263 sq. yd. in January, 1930, the present year has started off its paving program in most promising fashion.



Total concrete paving contracts, in Sq. Yd., in January—

	1930	1931
Concrete Roads	5,244,263	9,218,269
Streets & Alleys	1,350,314	889,208
Totals	6,594,577	10,107,477

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Although street and alley paving contracts fell below the awards in January, 1930, total paving contracts for the month are far ahead of a year ago, as shown in the diagram.

General Construction Contracts

Contracts awarded in January in the 37 states east of the Rocky Mountains for general engineering and building construction work are reported by the F. W. Dodge Corporation as totaling $227,956,400. While this is considerably below the total of $323,975,200 reported in January, 1930, some sections within the territory covered by the Dodge reports have come forward with substantial gains over a year ago. This fact is interpreted as a promising indication of renewed activity in general building and engineering construction.

Damage to Structures in Italian Earthquake Described

The structural effects of the Italian earthquake of July 23, 1930, are described by John R. Freeman, consulting engineer, Providence, R. I., in a bulletin published by the Seismological Society of America. The paper written by Mr. Freeman is based on information obtained during his personal inspection of the affected area.

"A Single Breaker May Recede,—But the Tide Is Coming In"

Business is on the turn. The demand for competent men will soon be setting in. When your turn comes, here's the means to find the man you want.

AMERICAN TRADE ASSOCIATION EXECUTIVES
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Engineering Societies Building,
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Engineering Societies' Employment Service,
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This work is the free contribution of these professional organizations to industry.

American Concrete Institute Moves Forward on All Fronts

Annual Meeting Sees Exchange of New Ideas and Developments in Making, Placing and Curing Concrete—Great Variety of Subjects on Milwaukee Program

MANY and varied were the subjects under discussion and development at the Twenty-Seventh Annual Convention of the American Concrete Institute, in session at the Hotel Schroeder, in Milwaukee, February 24, 25 and 26, as CONCRETE goes to press.

The Institute meeting was preceded by the joint annual convention of the Concrete Masonry Association and the Wisconsin Concrete Products Association, at the same hotel, on February 23, after which the convention activities of those two organizations were embodied in the program of the Institute.

The Cast Stone Institute, which has held former annual meetings in conjunction with the American Concrete Institute, will hold this year's convention later.

New Officers

Duff A. Abrams, director of research for the International Cement Corp., New York, was re-elected president of the American Concrete Institute for a term of one year; S. C. Hollister, professor of structural engineering, Purdue University, was re-elected vice-president for a 2-year term, and Harvey Whipple was re-elected secretary-treasurer. For the third, fourth and fifth districts, respectively, directors elected for a 2-year term were J. C. Pearson, Allentown, Pa.; P. H. Bates, Washington, D. C., and F. R. McMillan, Chicago, Ill.

Washington, D. C., was selected as the place for the next annual meeting, in February, 1932. The registration totaled just above 500, comparing quite favorably with previous years.

WORKABILITY AND ADMIXTURES

Several papers dealt with the question of admixtures and their effect on workability, a long-standing matter of interest. A well prepared contribution to the subject was made in a paper by G. M. Williams, professor of civil engineering, University of Saskatchewan, who reported comparative tests on six different admixtures. One of the six admixtures studied was portland cement itself—that is, additional cement above the quantity called for in the specifications for the test specimens; another was hydrated lime, and the remaining four were commercial admixtures, namely, "vankelad" (both A and B), Barnsdall admixture, and celite.

Prof. Williams explains that the underlying purpose of the investigation was that of establishing a standard and reliable method of test for the rating of admixtures rather than to discuss the merits or demerits of any particular kind or group. Admixtures, the author has found, do not appreciably affect strength or permeability when used in the amount or proportions specified by the manufacturer.

Prof. Williams defines workability as the ability of a mixture to remain homogeneous and free from segregation during the process of transportation and placement. He then arrives at the following two conclusions with respect to the effect of admixtures on workability:

(1) All admixtures tested, including portland cement as an admixture, increased the relative mortar volume, tended to reduce segregation, and showed merit as a means of increasing workability, although not to the same degree.

(2) The relative efficiency of admixtures in increasing workability (reducing or preventing segregation) is measured by the relative volumes of paste produced when equal weights of admixtures are made into pastes of approximately equal flowability.

All the admixtures tested were of the practically insoluble, finely divided powder form, and ranged in composition from silica and lime to clay in the form of bentonite.

Slump Tests and Flow Determinations

Also related to workability were two papers on slump tests and flow-table determinations. The first of these papers, entitled "A Study of the Flow-Table and the Slump Test" was presented by George A. Smith and Sanford W. Benham, of the Johns-Manville Research Laboratories. The second paper, by Inge Lyse, of the research laboratory of the Portland Cement Association, and Wm. R. Johnson, research assistant in the testing laboratory at Purdue University, was presented under the title of "A Study of Slump and Flow of Concrete."

In the tests by Smith and Benham celite was used as an admixture in some of the specimens. The tests by Lyse and Johnson included some samples containing either celite, hydrated lime or pumicite as admixtures, in varying amounts.

Arrive at Different Conclusions

Smith and Benham concluded that the flow test is more sensitive than the slump test in differentiating between changes in the wetness of concrete, and that the flow test is further found to be preferable because of its more nearly uniform functioning. The authors recognize that the slump test is the more convenient method for use on actual construction work.

Lyse and Johnson, on the other hand, concluded that the slump test is a somewhat better measure than is the flow-table test in determining the increased workability of concrete caused either by enriching the mixture or by the addition of admixtures. Their results also indicate that the slump test should be made without shaking of the concrete.

EFFECT OF WATERPROOFING ON PERMEABILITY

"A Study of the Effect of Waterproofings on the Permeability of Concrete" is the title of a paper presented by C. H. Jumper, of the United States Bureau of Standards. This paper covered the investigation of waterproofing compounds, both integral and surface-applied, under way for some time at the Bureau of Standards laboratories.

The investigation, as mentioned on page 26 of the December (1930) issue of CONCRETE, includes determination of the comparative effects obtained from some seventy-five commercial products that are sold as waterproofers of concrete. It is expected that an abstract of the results of the investigation will be published in a later issue of CONCRETE.

DURABILITY AND PERMEABILITY

The relation between durability and permeability, and the need for the qualities of density and impermeability in concrete exposed to soil or water or to general outside weather conditions, were discussed from many angles in a symposium by members of Committee 801 of the Institute. This discussion was led by F. R. McMillan, director of research of the Portland Cement Association, and R. B. Young, testing engineer of the Hydro-Electric Power Commission of Ontario. Most of Mr. McMillan's discussion dealt with information obtained from his field survey of many structures of various ages and conditions of exposure.

It was pointed out by several speakers that, while strength is the principal consideration in concrete in locations such as the structural frames and floors of buildings, density and impermeability are of much greater importance than strength in locations where concrete is exposed to soil, water or weather. The further fact was mentioned, too, that greater density and impermeability usually go hand in hand with greater strength.

PROPERTIES OF MASS CONCRETE

A summary of available information concerning the properties of mass concrete was presented in a joint paper by Raymond E. Davis, professor of civil engineering at the University of California, and G. E. Troxell, associate professor of civil engineering at the same university.

The paper is concerned mainly with a study of the effects of the rapid increase in temperature within the mass of concrete during the early hardening process, the gradual slowing down of heat production, and the slower process of cooling where concrete exists in large masses. It appears that in very large masses of concrete the cooling process may continue for several years.

In structures or parts of structures having thin sections, it is asserted, the temperature rise is too small to be of consequence, where ordinary portland cement is employed with normal mixtures of concrete. In contrast, the temperature rise may be as much as 100 deg. F. or more in concrete of massive proportions, as in large dams, heavy foundations, thick arches, and similar structures. In such massive structures the cooling process, in some instances, has been accomplished by cracking, indicating that large tensile stresses were being relieved, it is reported.

SHRINKAGE OF CONCRETE MASONRY

A report on "Tests of Shrinkage of Concrete Masonry" was presented by P. M. Woodworth, of the Portland Cement Association. The report describes further results of the shrinkage tests on walls of concrete masonry units conducted in the research laboratory of the Portland Cement Association. Earlier stages of these tests were described at the 1930 annual meeting of the Institute by W. D. M. Allan, in a report published in the 1930 Proceedings.

These tests have shown, in general, that it is bad practice to lay up concrete masonry units that are not completely cured, for it is during the curing of the unit that the greater part of its shrinkage takes place. In consequence, when uncured units are placed in a wall the shrinkage that is certain to occur in the individual units is likely to cause vertical cracks in the wall.

The tests have shown, also, that units cured by ordinary methods will accomplish most of their shrinkage during the first 28 or 30 days, after which time they may be placed in a wall. Where high-pressure steam curing facilities are available, almost complete shrinkage may be accomplished in 48 hours, a fact that was demonstrated in another series of tests described in brief on page 43 of the February (1931) issue of CONCRETE.

CONTINUOUS MIXERS IN PRODUCTS PLANT OPERATION

Benjamin Wilk, general manager of the Standard Building Products Co., of Detroit, with his paper on "A Comparison of Continuous and Batch Mixers in Plant Operation," re-opened an old subject under a new setting. In times past, discussions of the relative merits of batch mixers and continuous mixers found advocates on both sides. The old type of continuous mixer had its advantages because of the greater amount of concrete that could be mixed per day per dollar of investment. The batch mixer was favored by others because of its longer mixing time and the simplicity with which aggregates can be proportioned into the mixer.

New Type of Continuous Mixer

Until recent years most continuous mixers were built with short mixing troughs, many of them not more than 3 ft. long and with uncertain feeding devices. Mixing time was therefore very short, frequently less than one-half minute. Improvements in design during recent years, however, have resulted in continuous mixers with longer feeding troughs and more accurate feeding devices.

With the view of obtaining comparative results, a continuous mixer of the new type was installed at the plant of the Standard Building Products Co. and comparisons were made with the batch mixers in regular use at the plant.

Test Procedure and Conclusions

Tests were conducted over a period of six months at intervals of approximately one month. Each test consisted of two successive batches made in the batch mixer, followed by an equivalent amount in the continuous mixer. Control was obtained by measuring aggregates in a box of 1 cu. ft. capacity for the batch mixer and by determining the proper setting of feeding devices on the continuous mixer based on the yield in terms of block per sack of cement for the previous day's run.

The test results indicate that the variation between the strength of the block made from the continuous mixer of the long trough type and the usual batch mixer is very small, although the time of mixing in the continuous mixer is approximately one minute, compared with six minutes in the batch mixer. The belief is expressed that the concrete in the long-trough type of continuous mixer is given a thorough mixing because of the large number of paddles and the large number of revolutions per minute.

NEW MASONRY UNIT STANDARDS

P. M. Woodworth, chairman of Committee 708, presented for preliminary discussion a new "Recommended Practice for the Manufacture of Concrete Masonry Units." After further development based on the expected discussions and constructive criticisms, it is expected that the new standard will replace the Institute's present recommended practice in this field.

BURIAL VAULT SPECIFICATIONS

Another standard of interest to the concrete products industry was the proposed "Specifications for Concrete Burial Vaults," presented as a report of Committee 709, by C. A. Wiepking, member of the committee.

This committee, as stated on page 26 of the January (1931) issue of CONCRETE, is co-operating with other committees representing the National Concrete Burial Vault Association and the Portland Cement Association. The proposed specification calls for a 28-day compressive strength of 4,000 lb. per sq. in., and the water-cement ratio is limited to a maximum of 4¾ gallons of water to the sack of cement.

AGGREGATES FOR HIGHWAY WORK

Some interesting work has been accomplished during the past year in the investigation of aggregates for concrete highway construction, more especially in Kansas and Wisconsin. The investigation in Kansas was described in detail in the January (1931) issue of CONCRETE, pages 29-31. The investigation in Wisconsin was described at the Institute meeting by T. C. Thee, highway engineer, U. S. Bureau of Public Roads. This investigation was made for the purpose of studying sizes and combinations of aggregates most suitable for highway work. Mixtures with more than two sizes of aggregates were given special attention.

READY-MIXED CONCRETE

Ready-mixed concrete was under discussion in two papers, one of which was presented by Frank I. Ginsberg, author-chairman of Committee 602, on the subject of "Design and Operation of Central Concrete Plants."

Another paper comprised the report of Committee 503, of which Miles N. Clair, vice-president of the Thompson & Lichtner Company, of Boston, is author-chairman. This paper consisted of the proposed "Specifications for Ready-Mixed Concrete" which the committee has had under development for several years. On the recommendation of the author-chairman the proposed specification was given the status of a tentative standard.

CONSTRUCTION SPECIFICATIONS

Three construction specifications were up for discussion. The first was the "Tentative Construction Specification for Concrete Work on Ordinary Buildings," presented by Arthur R. Lord, author-chairman of Committee 502, and adopted a year ago as a tentative standard. The author-chairman moved for its advancement to the status of full standard.

Steel Reinforcement

The second construction specification presented was the proposed "Specification for Supplying, Fabricating and Setting Reinforcing Steel on Ordinary Buildings," offered as a report of Committee 503 by William F. Zabriskie, author-chairman. This proposed specification was presented a year ago and is now to be advanced to the status of tentative standard. This proposed specification covers in particular the manner in which steel reinforcement should be detailed and scheduled on plans in order to harmonize with the methods of the distributor of steel reinforcement. The specification may be embodied in a general specification for a building, at the point where steel reinforcement is covered, or it may be adopted by reference. If the specification is to be adopted by reference, the architect will find in the report the actual wording proposed for an adopting clause.

For the Small Job

The third of the construction specifications under discussion was the proposed "Specifications for Concrete Work on the Small Job," published in the September, 1930, *Journal* of the Institute, and thrown open to discussion at the Milwaukee meeting. This specification, as the title implies, is intended for use on the small construction job on which full-time inspection is not maintained. It is assumed that such work, to quote from the report, "will be awarded by the architect or engineer to honest contractors only, who can be depended upon to do high-grade work without close inspection." The specification explains to the less experienced contractor, by means of numerous notes, why the work must be done in the specified manner. Here it is assumed, again, that poor concrete work on small jobs is due to lack of technical knowledge rather than to indifference.

The three construction specifications just discussed constitute the first three of a new series of specifications under development by the Institute. The intention with all these specifications is to prepare them so that architects or engineers may incorporate them in their general specifications, practically without change.

REINFORCED CONCRETE COLUMNS

The second progress report of Committee 105 on its "Reinforced Concrete Column Investigation" was presented for discussion. This was followed by two progress reports, one setting forth the progress on the part of the prescribed tests being conducted at Lehigh University and the other dealing with the work at the University of Illinois. Each of the reports from the universities was prepared independently.

This column investigation includes, as its main feature, a vast program of load tests on full-sized reinforced concrete columns, the work of conducting the tests being divided between the two universities mentioned. It is expected that these load tests will supply more definite information than is now available for the development of formulas for designing reinforced concrete columns.

Results at Lehigh University

The results thus far attained at Lehigh University were reported by W. A. Slater, director, Fritz Engineering Laboratory, Lehigh University, and Inge Lyse, assistant engineer, Portland Cement Association, who is in immediate charge of the column tests at that university.

These tests have shown, among other things, that the difference in total strength of any two columns reinforced in the same manner was approximately equal to the difference in strength of the concrete in the core, as determined by the tests of the plain control columns.

The increase in total strength due to the use of longitudinal reinforcement was approximately equal to the yield-point stress of the reinforcement times its sectional area, regardless of the grade of reinforcement used.

Thus far the tests indicate that the strength of a column having longitudinal and spiral reinforcement is made up of the following elements:

(1) Eighty-five per cent of the cylinder strength times the net area of the concrete within the outer circumference of the spiral.

(2) The yield-point stress of the longitudinal bars times their area.

(3) The strength added by the spiral, which amounts to about 70 per cent of the strength added by an equal amount of longitudinal reinforcement of intermediate grade steel.

Results at University of Illinois

The test results obtained at the University of Illinois were reported by F. E. Richart, research associate professor, theoretical and applied mechanics, University of Illinois, and G. C. Staehle, associate engineer, Portland Cement Association, who has been assigned to this work.

In these tests three grades of concrete and three grades of longitudinal reinforcement were used. The concrete is referred to in the report as 2,000-lb., 3,500-lb. and 5,000-lb. concrete, and the three grades of longitudinal reinforcement were structural and intermediate grades of new billet steel and rail steel bars. The spirals were of intermediate grade of new billet steel.

LIGHT-WEIGHT AGGREGATES

As might be expected, because of the constantly growing interest in special aggregates of light weight, this subject occupied a prominent place on the program.

One of the papers on light-weight aggregates was a report by Committee 203 on "Cinders as Concrete Aggregate," presented by Einar Christensen, author-chairman. Another paper, entitled "Burned Clay and Shale Aggregate," was presented as a report of Committee 204, by George E. McIntyre, author-chairman. A third paper, presented by Frank A. Randall as author-chairman, Committee 406, covered the "Use of Light-Weight Concrete in Buildings."

Mr. Randall's report included the presentation of a complete design analysis for buildings of various heights and loadings with various weights of concrete (down to 50 lb. per cu. ft.). The paper discusses the remarkable effects obtained, in the design itself, through the use of light concrete, and the consequent economy of the structures.

DESIGN AND CONTROL ON DIABLO DAM

The outstanding paper on design and control of concrete work in the field of large construction projects was a joint contribution presented by H. F. Faulkner, assistant engineer, city of Seattle, and R. R. Hubbard, superintendent of construction, city of Seattle, under the title of "Design and Control of Concrete for Diablo Dam." Mr. Faulkner will be remembered as author of an article on curing of concrete pavements, in the issue of December, 1930, pages 19-20.

The Diablo dam is located in a very rugged section of the Cascades, on the Skagit River, about 100 miles northeast of Seattle. It is the second major unit to be completed in the development of that river for supplying hydro-electric power to Seattle. It is the middle one of three dams to be located on a 14-mile stretch of the river.

The central portion of the dam is of the constant angle-arch type, terminating at each end in gravity abutment sections in which are the spillways. The dam is 390 ft. high, with a crest length of 1,170 feet., and an extreme thickness of 140 ft. at the base and 16 ft. at the crest. The structure contains 320,000 cu. yd. of concrete.

At a large bend in the river about one-half mile below the dam site was an extensive sand and gravel deposit. The material was examined and tested and found suitable for the purpose. After making and testing a number of specimens from various trial mixtures, one using 20 lb. of cement to 160 lb. of combined aggregate was decided upon as being most suitable. Making certain allowances for the rather coarse sand (fineness modulus of 3.46) and the elongated shape of the coarse aggregate, and on the basis of the fineness modulus table, the selected mix had the following proportions, by weight:

1.0 part of cement
2.3 parts of sand
3.5 parts of medium aggregate
2.2 parts of coarse aggregate

This mixture, with a water-cement ratio of 5⅝ gallons of water to the sack of cement, produced concrete that developed an average 28-day compressive strength of 3,200 lb. per sq. in. The slump, when coarse aggregate larger than 2 in. was removed, averaged 3½ in. The cement content was 1.19 barrels to the cu. yd. of concrete in place. Permeability discs, 6 in. thick, when subjected to a pressure of 100 lb. per sq. in. for 72 hours, remained dry on their unexposed faces for the entire period.

ANNUAL DINNER

The annual dinner was held on Wednesday evening, February 25, as a joint affair with the Engineers' Society of Milwaukee and the Associated General Contractors.

A pleasing feature of the dinner was the presentation of the Leonard C. Wason medal for the "most meritorious paper at the 26th Annual Convention" to I. E. Burks, for his "Concreting Methods at Chute-a-Caron Dam." The presentation was made by President Abrams, of the Institute.

Form Details and Practice Developed for Architectural Concrete

Use of Fiber Board Lining—Waste Molds and Their Manufacture, Use and Removal—Proper Proportions Imperative in Architectural Concrete

ARCHITECTS in various sections have signified their interest in the possibilities of monolithic concrete exteriors for buildings, of the type of construction built so extensively on the Pacific Coast.

This type of construction has in fact been employed in buildings of all manner of occupancy in all parts of the United States and Canada, and its practicability for cold climates as well as for the more moderate climate of the Coast has been well established.

With respect to the structural features of form work for concrete walls above grade, in buildings of this type, these are quite thoroughly detailed and described in Chapter 7.[1] That chapter, and Figures 37 to 42,[1] inclusive, should therefore be studied carefully in conjunction with the description and illustrations given here.

Requirements of Form Work

The form work for architectural concrete, however, must have more than structural strength, for the reason that the concrete must be more than structural concrete. The concrete, in addition to being structurally sound, must be dense and must have a smooth and true finish. The ornamental details must have a clean-cut appearance equal to that of cast stone or natural cut stone.

In view of the requirements just enumerated, the form work must not only have structural strength and rigidity, but it must be lined with materials that will produce the kind of surface texture desired. Provision must be made in the structural form work of the plaster molds (commonly termed waste molds because they are destroyed, or "wasted," when the forms are removed) with which the most highly ornamental work is obtained.

Special Practices Developed

Inasmuch as the main structural features of the form work on the Coast are similar to those given in Chapter 7,[1] this appendix will be confined largely to the special practices developed there. These special practices relate in particular to the manner in which ornamental work is cast in place, to the method of placing precast ornamental work in the forms, and the use of fiber board lining which in turn permits the use of the cheapest grades of form lumber for the structural parts of the form work.

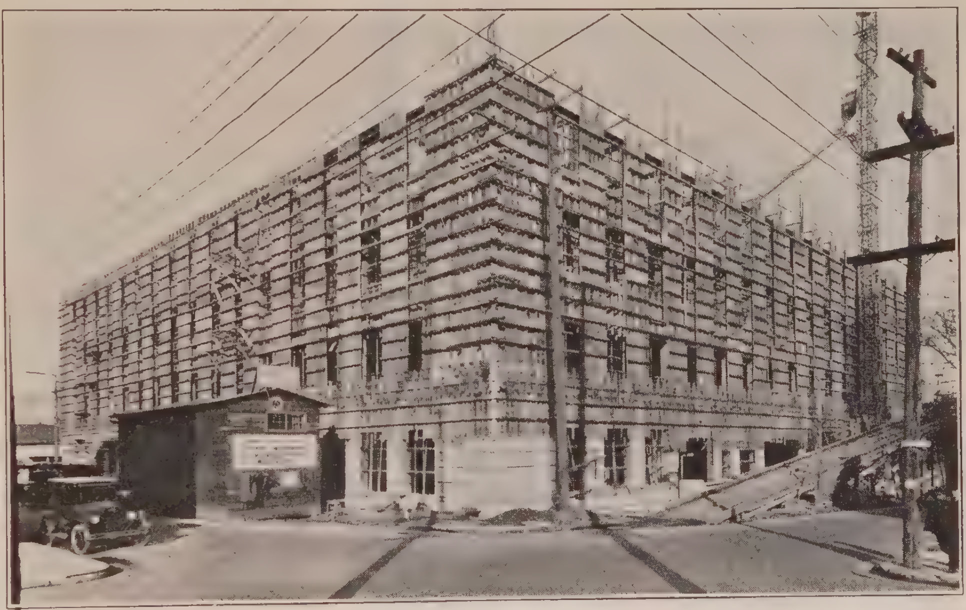

Figure 1. Form work for 4-story warehouse with monolithic concrete walls

Four-Story Warehouse

Figure 1 is a view of the form work for a 4-story warehouse in Portland, Oregon. The building has exterior walls of monolithic concrete. The illustration is quite typical of this class of work. For instance, the forms for the entire height of the building were in place at the same time, although when this picture was taken stripping had been started and the forms had been removed from the first story walls. No fiber board lining was used, so that the form lumber employed was a clear grade.

The use of fiber board lining is well illustrated in Figure 2, a view taken from the interior of a high class, two-story business building known as the Lion Building,

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Reproduced from reprint, "How to Save in Concrete Form Work" (Concrete Publishing Company), where it appeared as Appendix.

[1] See also CONCRETE (July), 1930, p. 38.

under construction at the northwest corner of Wilshire boulevard and Catalina street at Los Angeles. This view of the form work shows the fiber board (the dark colored material) in place over the greater part of the form surface. This lining material, with which most builders are familiar, is manufactured in large sheets and then cut to the required sizes.

All the form work intended for flat wall faces was lined with this fiber board, the corners rubbed down with sandpaper and the surface coated or greased with a form oil of thick consistency, which was then wiped off as clean as possible with rags.

Observe in particular the vertical beveled strips beside the window opening in Figure 2. These strips form the vertical fluting such as may be seen in Figure 3, showing the corner of the completed building. These strips for the fluting were made of carefully selected kiln-dried spruce, which was carefully planed and the grain filled with lead and oil before being nailed to the forms.

In order to obtain true, sharp edges in architectural details such as vertical fluting, and to prevent any tearing of the green concrete when the forms were removed, all butt joints between strips and all cracks between the strips and the fiber board were filled with putty. The putty prevented the intrusion of mortar between the strips and the fiber board, thereby preventing a condition that would have been sure to cause ragged edges when the forms were removed.

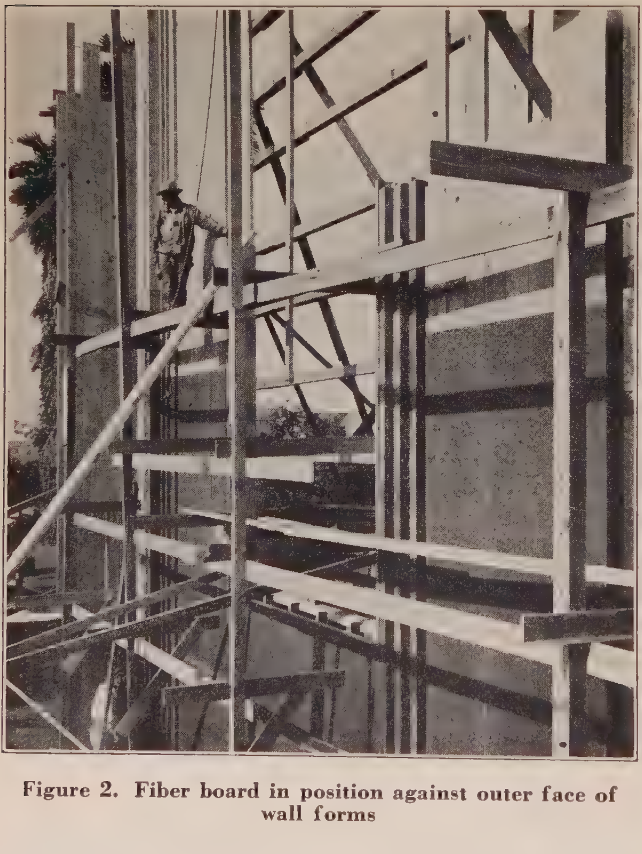

Figure 2. Fiber board in position against outer face of wall forms

A similar treatment of wood is necessary wherever this material is employed (usually in panels) for molding the finished surface. Wood is often used for the finished form surface in cases where the surface texture is such that advantage may be taken of the effect of impressions of the grain and the marks or joints between boards. In addition to spruce, California white pine and eastern white pine are suitable because of the closeness of the grain and the smoothly planed surfaces that may be obtained.

How Waste Molds are Made

Before describing the use of waste molds it will be well to discuss the manner in which they are made, for their use will then be better understood.

These molds are usually made by starting with the clay models which the architect has approved. From these clay models the plaster reverse molds (or waste molds) that constitute the ornamental forms are made. The waste molds are sized with two coats of thin shellac, to prevent the absorption of moisture from the concrete, and consequent disintegration. These plaster molds are reinforced where necessary and are provided on the back with wooden strips so as to permit their being nailed to the outside part of the structural form work at top and bottom. To prevent breakage, these molds are usually shipped packed in sawdust.

Use of Waste Molds

The use of waste molds in the building illustrated in Figure 3 is quite clearly shown in Figures 4 and 5. Figure 4 is an interior view of one of the street front walls of the building illustrated in Figure 3, and it shows a longitudinal panel of waste molds in place. This picture (Figure 4) also shows the "placing boxes" in the form work which will receive three waste mold panels, such as the one shown in Figure 5.

Figure 5, in turn, is a rear view of one of the waste mold panels that will go into one of the "placing boxes" just mentioned in connection with Figure 4. This waste mold panel will be fitted into the opening which has been provided for it. The strips on the back of the panel will be nailed into the structural form work at the top and bottom.

The three panels just below the second story window near the corner of the building (see Figure 3) are typical architectural features of the type that must be made with waste mold panels.

Corner Details

Figure 6 is a close-up view of the corner detail and (at the left) the small pilaster at the side of the first story window opening. This is at the street corner of the building, best shown in Figure 3.

Figure 7 is a picture of the form work for the corner detail shown in Figure 6. This picture shows how the various angles and faces at this corner have been formed with 2-inch material, planed on both faces and both edges, and sized as previously described in connection with the vertical fluting strips. Observe how the dressed vertical strips are supported on blocking built in from the horizontal waling timbers.

Mixing and Placing Concrete

Concrete must be mixed to the proper consistency, for an excess of water will ruin the surface. It is necessary, of course, that advance experiments be made with the materials at hand, so that the proper proportions between cement and aggregates, between fine and coarse aggregates, and between cement and water, will be known before actual placing of concrete is started. Mixing proportions may vary all the way from 1:2½:3½ to 1:2:3. The proper consistency of concrete for plain surfaces will most likely be such as to produce a slump of 4 to 5 inches. For ornamental work it may be necessary to employ a more plastic consistency, from 7 to 8 inches of slump, in order that the concrete may fill all parts of the molds.

In placing the concrete it must be continually puddled, but care must be taken to prevent the marring of molds during the act of puddling. It must be placed also so that the surface of the fresh concrete remains nearly level.

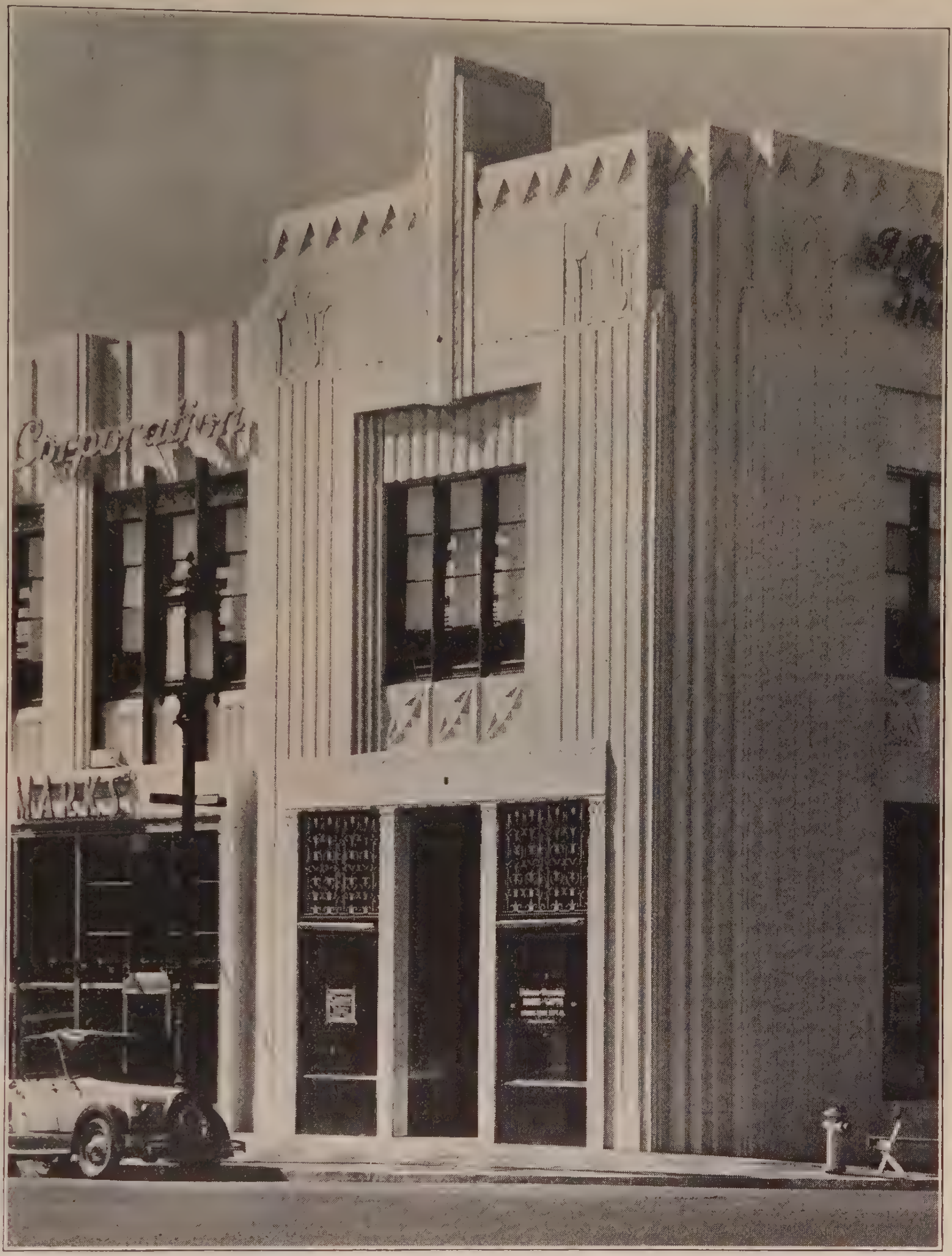

Figure 3. Lion Building, at Los Angeles, illustrating marvelous architectural possibilities of molded concrete

In no case should the concrete be allowed to flow along in the forms.

Day's Work Planes

Day's work planes must be made. Although it is impossible to prevent the appearance of a line or mark at a day's work plane, its appearance is not objectionable if it takes the form of a horizontal straight line. This is accomplished by tacking a dressed 2 by 2-inch horizontal strip of wood within the wall form, against the outer face of the form, and at the level where the concreting is to be stopped for the day.

The fresh concrete is then placed to a level about ½ inch above the lower face of the strip and is sloped downward toward the inner face of the wall. The purpose of the slope is to conduct laitance, surface water, and the like, toward the inner face of the wall, rather than to permit it to mar the exterior surface.

About two hours after the concrete has been placed the strip is removed and the entire surface of the concrete, including the narrow horizontal surface formed by the bottom face of the strip, is cleaned with a stiff broom. In this manner the line between the two days of concreting is straight and horizontal, inconspicuous and not objectionable. All laitance having been removed, a good bonding surface is provided for the next placing of concrete.

Stripping the Forms

Under normal warm weather conditions the forms should not be removed until six or seven days after the concrete is placed. Leaving the forms in place this length of time has two advantages. First, the form work helps to retain the moisture in the concrete, thereby aiding the curing process. Second, the better cured concrete is well hardened and therefore less likely to be damaged by the removal of forms. Immediately after removal of the forms, the exposed surface of the wall should be given a wire brushing to remove fins and surface films.

The waste molds are left in place until the building is practically completed. The purpose of this is twofold:

First, it permits the concrete back of the molds to cure under almost ideal conditions. It also protects the ornamentation from damage during construction. After the building is completed the concrete will have attained a strength sufficient to permit the breaking off of the waste molds without endangering the ornamentation. The decoration may then be cleaned with wire brushes and allowed to dry out until it is uniform in color. It may then be treated with a fine dash of colored stucco or oil stain so as to produce polychrome effects.

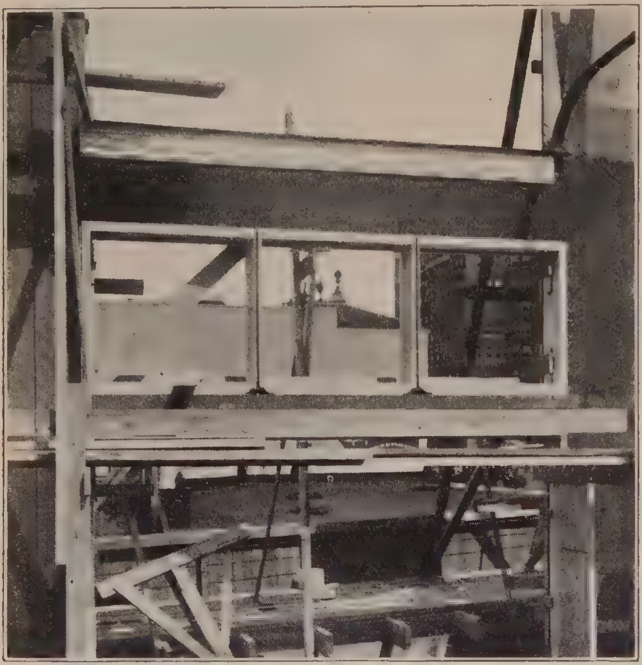

Figure 4. Outer face of wall forms, with "placing boxes" for plaster molds built in

Patching

If the surface of the concrete is marred, or if unforeseen pockets occur in the surface, patching becomes necessary. For making patches a cement-and-sand mortar is employed, the proportions between water, cement and sand being the same as the proportions between these ingredients in the concrete. As a rule the mortar is taken directly out of a batch of the concrete, the coarser stones being flipped out with a trowel.

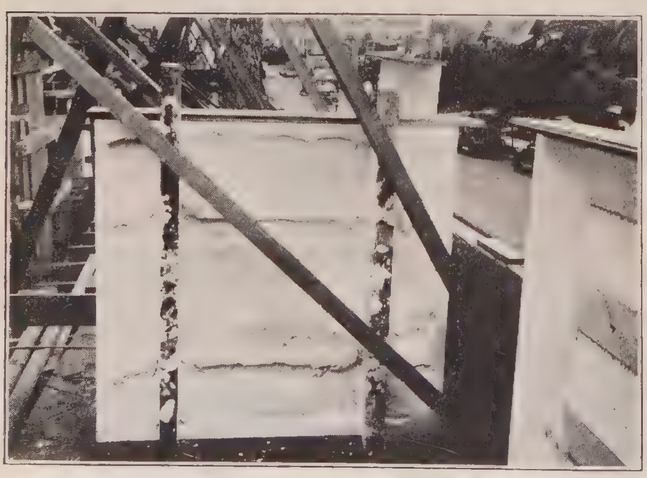

Figure 5. Rear view of one of three plaster molds to be set in the "placing box" in Figure 4

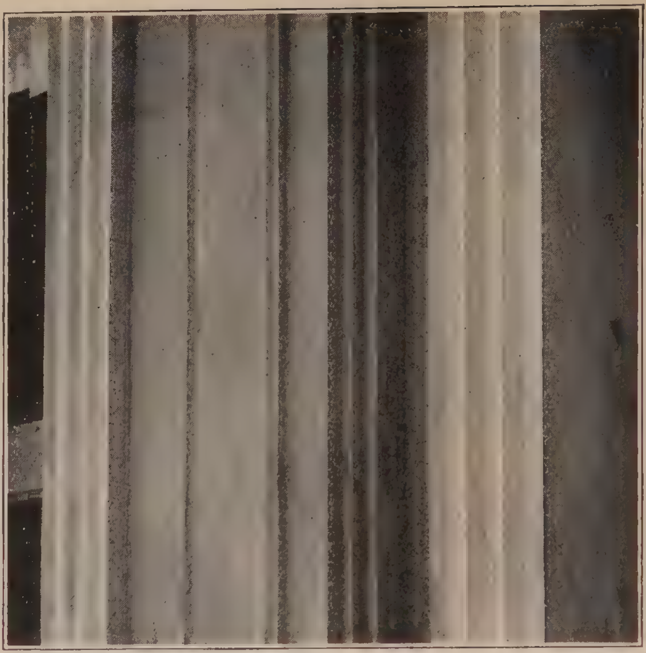

Figure 6. Close-up view of corner detail

Architecture of Molded Concrete

Returning again to Figure 3, it is worth careful thought and study, because it is, in reality, a typical illustration of the marvelous architectural effects attainable in molded concrete. The architects to whom credit is due for this commendable example are Walker & Eisen, of Los Angeles.

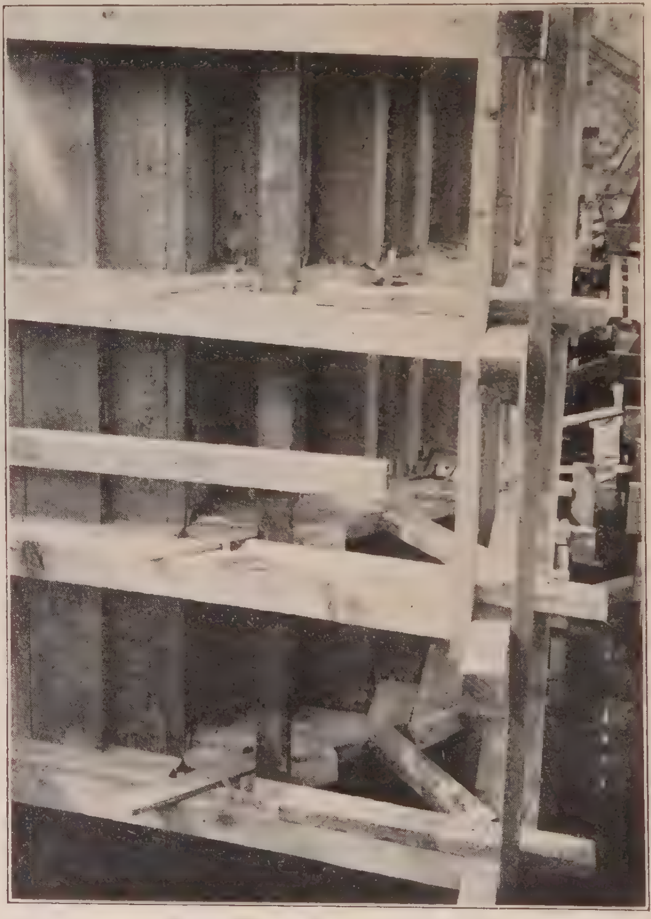

Figure 7. Form work for corner detail shown in Figure 6

Dependable Quality is Watchword of Ready-Mixed Concrete Group

Attendance at First Convention Greater Than Expected —Emphasize Quality and Describe Means of Attaining —Some Plant Operations

AN unexpectedly large number of delegates appeared at the first annual meeting of the National Ready-Mixed Concrete Association, held at the Jefferson Hotel in St. Louis on January 26. Following a morning session in a room crowded to capacity, it was necessary to obtain larger quarters for the afternoon program.

Walker Discusses Yield

Notable among the papers presented before the meeting was one by Stanton Walker, director of the engineering and research division of the National Sand and Gravel Association, on "Yield of Aggregates in the Design of Concrete."

After pointing out the necessity for accurate and convenient methods for estimating quantities of materials in ready-mixed concrete operations, Mr. Walker outlined and explained a simple method which can be applied to the problem. The method is based on the absolute or solid volume of the materials composing the concrete. This method is said to be accurate within two or three per cent, so long as—

(a) The concrete is plastic and workable, and all voids in the aggregates are filled with cement paste.

(b) No water is lost, such as frequently happens with extremely wet mixtures.

(c) No important amount of air is entrained.

The quantity or volume of concrete produced by given quantities of materials consists, therefore, of the sum of the following four items:

(1) Volume of mixing water (the actual volume, since the water has no voids). Surface moisture is included.

(2) Volume of solids in cement.

(3) Volume of solids in fine aggregate.

(4) Volume of solids in coarse aggregates.

The solid volume of a cement or an aggregate is, of course, the complement of its voids. For illustration, sand that has 35 per cent of voids will have 65 per cent of solid matter.

Design of Concrete Mixtures

A paper on "Design of Concrete for Strength, Impermeability and Workability" was presented by A. T. Goldbeck, director of the bureau of engineering of the National Crushed Stone Association.

Mr. Goldbeck pointed out the fact that the producer of ready-mixed concrete must be equipped to make concrete in compliance with two different types of specifications. One type of specification calls for certain fixed arbitrary proportions, such as 1:2:4, while the other type requires the production of concrete that possesses certain specified qualities of strength and workability. Mr. Goldbeck's paper was concerned mainly with the second type of specification.

Proposes a Strength Specification

J. L. Shiely, president of the J. L. Shiely Company, of St. Paul, producers of ready-mixed concrete, proposed a "Suggested Strength Specification."

Considering his subject from the viewpoint of the producer, Mr. Shiely declared that, first of all, the suggested strength specifications must call for the highest quality of concrete that is practically attainable. There must be no compromise between quality and commercial expediency if a ready-mixed concrete business is to prosper.

Operation of Ready-Mixed Concrete Plants

Three papers on operation, all of which drew out much discussion, were presented at the afternoon session of the convention. R. B. Young, consulting engineer for Toronto Ready-Mixed Concrete, Ltd., presented a paper on "Operations of Ready-Mixed Concrete Plants in Canada." Alexander Foster, Jr., vice-president of Warner Company, Philadelphia, described the operating features of several plants established in Philadelphia by that company, which were fully described in the October (1930) issue of CONCRETE, pages 19-22. J. C. Eakin, secretary of the Big Rock Stone and Material Co., of Little Rock, Ark., described the operation of the ready-mixed concrete department of that company.

The User of Ready-Mixed Concrete

Speaking as a user of ready-mixed concrete, Henry D. Johnson, Jr., designing engineer in the bureau of bridges of the city of Pittsburgh, presented a paper entitled "Premixed Concrete from the User's Viewpoint."

When the engineer or architect is confronted with the proposal to specify or permit the use of premixed concrete, a number of questions enter his mind. The producer of premixed concrete must not only be able to answer those questions, but he must be able to prove that the answers are right. Among these questions the writer listed the following:

(1) Does the plant maintain facilities for the inspection and testing of cement and aggregates?

(2) Can the company supply concrete according to water-cement ratio specifications?

(3) Can the company supply concrete in sufficient quantities for large runs?

(4) Does the method of transporting concrete insure that concrete of proper quality and workability will be delivered?

Meetings of Aggregate Associations Discuss Making of Concrete

St. Louis Conventions Give Much Attention to Ready-Mixed Concrete and Concrete-Making Properties of Aggregates—Procedure for Sodium Sulphate Test

THE 14th annual meeting of the National Crushed Stone Association and the 15th annual convention of the National Sand and Gravel Association, both held in St. Louis in the latter part of January, were productive of many interesting papers and discussions dealing with the making and placing of quality concrete.

Commercial Aspects of Ready-Mixed Concrete

Outstanding among the papers presented before the meeting of the National Crushed Stone Association was one on "Commercial and Production Aspects of Ready-Mixed Concrete," presented by H. F. Thomson, vice-president of the General Material Co., of St. Louis, and in active charge of the ready-mixed concrete department of that company.

Sand and Gravel Association Papers

Several papers presented before the meeting of the National Sand and Gravel Association were of exceptional interest to the concrete construction industry. These papers were included in the appendix of a complete engineering report presented by the engineering and research division of the association.

Program of Activities in Research

The engineering report contained, among other features, an outline of the research activities contemplated or in progress. Following are a few of the activities mentioned:

(1) Effect of characteristics other than grading on concrete-making properties of coarse aggregates.

(2) Effect of size and grading of aggregates on the quality of concrete.

(3) Methods of proportioning concrete. The development of a logical and scientific basis of proportioning is the purpose of this investigation.

(4) Test of concrete-making properties of sands.

Sodium Sulphate Test Procedure

One of the papers in the appendix of the engineering report previously mentioned proposes a method of test for soundness of fine and coarse aggregates by the use of sodium sulphate. No originality is claimed for the method. It is primarily a compilation of what is felt to be the best available practice and thought at the present time.

The method describes the procedure to be followed. To begin with, a prepared saturated solution of sodium sulphate shall be added to the fractions of samples in the containers, in a quantity sufficient to cover them to a depth of about one-half inch. The containers shall be covered to reduce evaporation and to prevent the addition of extraneous substances. The immersed samples shall be stored at a temperature of 70 deg. F., with a tolerance of 4 deg. plus or minus, for a period of 18 hours.

After the 18-hour immersion period the sodium sulphate solution shall be siphoned or decanted from the container. The samples, in the container, are then placed in a drying oven. The oven shall have been previously brought to a temperature from 212 to 230 deg. F. Care must be exercised to avoid loss of any of the aggregate particles or detritus coarser than 100-mesh. The samples shall be dried to constant weight, or for not less than four hours, at the specified temperature. After being dried, the samples shall be allowed to cool to room temperature, when they shall again be immersed in the prepared saturated solution in the manner described.

The process of alternate immersion and drying shall be repeated until the required number of cycles are obtained. Unless otherwise specified, five cycles constitute a test.

Effect of Size and Grading of Aggregates

A paper of exceptional interest, on the "Effect of Size and Grading of Fine and Coarse Aggregate on the Strength of Concrete," was presented by Stanton Walker,[1] director of the engineering and research division of the National Sand and Gravel Association. While the paper is primarily a review of published tests on this subject, rather than a report of original investigations, the following conclusions are justified from the data studied:

(1) Variations in the maximum size of similarly graded coarse aggregates have comparatively little effect on the compressive and flexural strength of concretes for a wide range in maximum size. The data are definite in showing that there is no economy in placing a premium on one size as compared with another when differences in maximum size of the order of ½-in. are involved.

(2) Amounts of intermediate and finer sizes in aggregates of the same maximum size may vary over a relatively wide range without affecting the strength or yield of concrete an important amount. So far as strength and yield is concerned, the data are entirely definite in showing that usual specification limits are sufficiently rigid to insure uniformity; some advantages are exhibited for the coarse aggregates containing the higher percentages of smaller sizes.

(3) The ordinary interpretation of sieve analyses of sands do not give an accurate measure of their concrete-making properties. The strengths of sand mortars expressed as a ratio to the strength of similar standard sand mortars furnish no directly applicable information as to the concrete-making properties of sands.

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[1] See also Mr. Walker's discussion of this subject on page 49 of the February (1931) issue of CONCRETE.

Where Cost Economies Are Gained in Concrete Highway Bridges

Reducing Maintenance Costs — Field Control of Construction—How Expansion Joints May Be Avoided—Life of Structure Depends on Location

By C. B. McCULLOUGH
Bridge Engineer, Oregon State Highway Department

A detailed discussion having exceptional value to highway bridge departments was presented by Mr. McCullough in a paper read before the December meeting of the Highway Research Board in Washington. In so far as the paper deals with maintenance and obsolescence, it is presented here in slightly condensed form. That part of the paper that deals with economies in first cost will be abstracted in a later issue.—The Editors.

THE cost of a concrete bridge is the collective aggregate of several component items. For this reason it becomes necessary, in approaching the question of cost reduction, to effect a segregation and to consider each component item of cost separately, and in turn.

Neglecting such factors as are not affected by the discussion which follows, the expression representing the annual expense chargeable to the construction of any concrete bridge may be written as follows:

Annual Cost $= (r + m + a)\ C$

wherein:

r = the annual unit cost for capital (i. e., the interest rate expressed decimally).

m = the annual average unit cost for maintenance, per dollar of first cost.

a = the annual amortization cost (i. e., the sum, per dollar of first cost, which, if deposited at compound interest, would accumulate a sinking fund sufficient to renew the structure at the end of its service life).

C = the total first cost of the structure, in dollars.

The total annual cost may be reduced by the reduction of any one or more of the above four factors. It is obvious that a reduction of the term "*r*," the annual interest rate, is a problem in finance and administration rather than engineering.

Our problem comprises the reduction of one or all of the factors "*m*," "*a*" and "*C*." Let us consider each in turn.

Maintenance Work on Concrete Bridges

How may this cost item be reduced? Perhaps this inquiry may be best answered by a consideration of those items of expense falling under this classification which are most commonly encountered throughout the year's work. What are the maintenance crews doing to these bridges? Why it is being done, and how may this work be avoided or curtailed? Let us speculate as regards the answer to each of these inquiries.

What are the maintenance crews doing on concrete bridges? It is safe to say that they are engaged in some one or more of the following items of work, in the majority of instances at least:

(a) Protecting stream banks.

(b) Underpinning, riprapping or otherwise safeguarding foundations.

(c) Repairing damaged handrailings or balustrades.

(d) Cutting loose a jammed expansion joint somewhere in the structure, re-anchoring a loose expansion floor plate or refilling open expansion joints with tar or asphalt.

(e) Chipping out an opened-up construction joint and waterproofing the same.

(f) Applying a waterproofing to shrinkage cracks in the deck.

(g) Attempting to remedy surface disintegration by patching, or the application of a waterproof blanket of some one of several types.

Eliminating Some Maintenance Items

Why are the crews engaged in this work and how may these items be eliminated or curtailed?

Items "a" and "b" oftentimes go hand in hand. Sometimes such expense is unavoidable, but many times it is the result of a failure to study stream conditions, or improper location of the structure in reference to the waterway, inadequate provision for horizontal and vertical span clearances, or inadequate foundation depths.

Item "c" is of course the direct result of a rather lawless and headlong traffic — traffic which sideswipes handrails and crashes through curbs in spite of every precaution to the contrary, and a traffic which, regret it as we may, will always be with us to a certain extent, at least. Again it must be admitted that a portion of this expense seems inevitable, although it appears possible to curtail it to some extent through the employment of the following design precautions:

(1) Adequate roadway widths.
(2) Curb protection which is high and wide.
(3) An intelligent entrance treatment.
(4) Careful attention to alignment.
(5) The provision of bull's-eye reflector type traffic

lights in the ends of the curbs on the side of approaching traffic.

(6) Other similar traffic safety precautions.

How Expansion Joints May Be Omitted

Item "d" is the direct result of an articulated structure, that is to say, one in which the superstructure is separated from the substructure or from the adjacent superstructure spans (or both) by means of expansion joints. In a later installment of this paper, dealing with methods for reducing first costs, it will be shown that a considerable first-cost economy may be effected through the elimination of expansion joints, converting the structure into one monolithic continuous elastic frame, and that this method of design is adaptable not only to single span structures but also to multi-span structures on elastic supports. The utilization of this principle goes far toward the entire elimination of expansion joints, thus curtailing this item of maintenance expense to a considerable degree. With our present knowledge of the art, it has not been possible completely to do away with expansion joints, but only to reduce materially the number needed. Multiple, short span, elastic frames up to 250 feet in length (or perhaps longer) may be constructed as continuous monoliths, and it is doubtless equally feasible to construct concrete arches of like dimension with the arch rib and the supported superstructure built monolithic and continuous. Above this limit, however, expansion joints appear to be needed; but where they are thus needed and used, a further reduction in maintenance expense may be effected through a careful attention to the details of their design and installation.

Avoiding Effects of Inferior Construction

Items "e," "f" and "g" are the result of inferior construction practices and may be eliminated to a great extent by giving constant attention to the following construction details:

(1) Adequate and proper bonding and waterproofing of construction joints—the employment of copper or galvanized metal water stops and like design and construction precautions.

(2) Proper and adequate curing of all concrete, and particularly the roadway surfaces.

(3) In general, by giving proper attention to the proportioning, mixing, placement and field manipulation of concrete to the end that the material will be dense and waterproof to the maximum possible degree, and that the surfaces will be free from stone or sand pockets, laitance seams or other imperfections.

Summary of Maintenance Reductions

Notwithstanding the fact that maintenance expense on a concrete bridge is a comparatively small percentage of its first cost, yet this expense is far from being too small to merit a painstaking attempt looking toward its further reduction. Maintenance costs may be reduced below their present values. This reduction, in general, may be effected through observance of the following basic principles, summarized from what has already been set forth:

(1) Greater care in the study of stream conditions and of the factors affecting the location of the structure.

(2) A more painstaking attention to design detail.

(3) Closer attention to field control of materials and workmanship.

(4) The employment of monolithic elastic units wherever possible, thus cutting the expansion joints to the lowest possible number.

Amortization Costs

The term "*a*" in the "Annual Cost" formula at the beginning of this article, representing the annual cost per dollar of capital for amortization of capital, is generally computed from the expression—

$$a = \frac{r}{(1+r)^n - 1}$$

wherein

r = the annual interest rate, expressed decimally;

n = the service life of the structure, in years.

From the above expression it is apparent that the factor "*a*" can only be reduced through an increase in the service life "*n*" of the structure.

The same design and construction factors which operate to produce high maintenance expense obviously militate against the life of the structure as well. However, since it is possible to so budget the maintenance as to cure these difficulties as they arise, any concrete bridge may be kept up to its initial condition as regards strength and serviceability in perpetua.

The above being true, there remains but one condition which can curtail the service life of a concrete structure. That condition is *obsolescence.*

Obsolescence

A structure may become obsolete as regards several of its physical attributes. It may become obsolete as regards its roadway width, its alignment, its gradient or its general location.

An obsolete roadway width, considered alone, will not furnish a sufficient reason for reconstruction, inasmuch as a betterment expenditure for widening is generally feasible and practicable. If, however, either in connection with an inadequate roadway width or entirely independent of roadway considerations, a structure lies upon an alignment or a gradient which is inadequate for traffic needs, or if it forms a link in a larger roadway section which is inadequate or obsolete as regards alignment or grade or general location, then the life of the structure is curtailed and this curtailment is more or less independent of those considerations enumerated in our discussion of maintenance costs.

The amortization factor for any concrete bridge therefore hinges largely upon its location and the location of the general highway sector of which it is a part.

The factor "*m*" is a small one in any case where permanent construction is employed. This statement does not hold for the amortization factor "*a*." Inadequate locations in many instances have rendered structures, which would otherwise have remained in service for fifty years or more, completely obsolete in ten years.

Too much emphasis cannot be placed upon this phase of structural economics, nor upon the pressing and urgent need for a more painstaking and thorough study of traffic trend and traffic needs as a condition precedent to the location of any permanent bridge.

HOW TO DO IT

✦ **Questions and Answers** ✦
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Concrete Pits to Resist Acids and Alkalies

We are designing a series of reinforced concrete pits to house a waste water heat-exchanger unit. These pits will be constructed below the surface of the ground, and will be subject to the action of hot water, which may be either in an acid or an alkaline condition, such as would exist in the waste water coming from laundries, cleaning establishments and the like. The size of these pits range from a small size to a maximum of 10 by 20 ft. in plan and 10 ft. deep.

Please send us information regarding waterproofing of the concrete, suggested mixtures of concrete and any special methods of mixing, improving the resistance of concrete to the action of hot water, acids and alkalies, and any other data that may assist us in designing these pits.—F. L. W., Baltimore, Md.

Considering the severe service to which the reinforced concrete pits are to be subjected, the case is one that calls for both strength and density in the concrete itself.

As to the strength requirements, the specification should require a water-cement ratio of not more than 5 to 5½ gallons of water to the sack of cement. The volume of fine aggregate should be a little more than the volume of coarse aggregate, and the combined aggregates should be such as to produce a slump of 3 to 4 inches if the pits are lightly reinforced, and around 6 inches if heavily reinforced. The proportions necessary to attain such slumps will of course vary with different aggregates; but for a water-cement ratio of 5½ you should find a 1:1½:2½ mixture not far from right. Only by actual experiment with the aggregates known to be intended for the work can the exact proportions be determined.

These or similar requirements should be definitely included in the specifications; but to insure compliance with the specifications the work must be carefully inspected during the placing of the concrete. Furthermore, the inspector should be supported by means of sections in the specifications requiring the concrete mixing plant to be equipped with an approved automatic device for controlling the time of mixing, and an approved water-control device. These devices must be provided with locks so that they can not be adjusted by any one except the inspector or some one authorized by him.

The density of concrete which is to be subjected to severe service of this nature must be such that water will not penetrate it under ordinary pressure. Ordinary hand tamping or hand puddling methods should not be depended upon to attain such density. On the contrary, electric-driven or compressed air-driven tampers or vibrators should be specified, so that the concrete will be vibrated into all corners and around the reinforcement, and air pockets will be reduced to the minimum.

An acid-resisting coating applied to the inner surface of the pits after the forms are stripped will then add further assurance of satisfactory service. A list of manufacturers of waterproofing coatings will be found on page 9 of each issue of CONCRETE.

Cement for Terrazzo Floors

I understand that a specially hard cement is used in terrazzo floor construction. Can you give me the name of the manufacturer of such cement?—B. M. O., Holland, Mich.

No special cement is used for this purpose. Any brand of standard portland cement or high-early-strength portland cement may be employed.

The terrazzo floor material that is specially selected is the coarse aggregate, which usually consists of marble chips or some equally hard material.

It may be of interest to you to know that the National Terrazzo and Mosaic Association, 809 St. Paul Avenue, Milwaukee, is about to issue a new specification for laying terrazzo floors.

Use of Large Sizes of Coarse Aggregate

In this locality we have a high grade of gravel available for concrete work, and from some sources the sizes range up to 5 or 6 inches. Unfortunately, we are handicapped in its use because, as a general thing, specifications arbitrarily impose size limitations ranging from 1 to 2 inches, depending on the nature of the work or whim of the specification writer.

Is it not a fact that coarse aggregates of large size can be and have been used to good advantage? If so, what are the principal points to be watched?—B. R. T., Jefferson City, Mo.

It is true that the use of large sizes of coarse aggregates, ranging in size up to 6 inches or more, is on the increase in massive concrete work. The use of large sizes will increase the yield to some extent, provided the coarse aggregate is sufficiently well graded so that some of all sizes are present.

One limitation which a number of engineers recommend is that the largest size shall be no greater than one-fourth the thickness of the wall or slab in which the concrete is placed. This automatically limits the maximum size for highway work to about 2 inches. In massive work, such as dams, piers or heavy foundations, this limitation is of little consequence.

The use of large sizes of coarse aggregate increases the difficulty of puddling concrete by ordinary methods. This difficulty, however, can be overcome by the use of electric-driven or compressed air-driven vibrating equipment.

The practice of arbitrarily excluding large sizes of aggregates by specification, in localities where such sizes occur in natural deposits and in work sufficiently massive, is wasteful and inexcusable.

The Concrete Industry
—25 YEARS AGO

"PROGRESS in concrete construction during the past year has been most notable along the lines of improvements in its appearance, to enable it to be used for face work in the higher classes of buildings where good architectural effect is essential," states Charles D. Watson in the February, 1906, issue of CONCRETE.

" . . . plastering the surface seems so far to be the most common method employed. Contractors should assist architects in their endeavors to give concrete individuality in design, by giving them their experience in its treatment, and by following out the architect's ideas as closely as possible, as to color and finish," he continues, in an article entitled "Manufacture of Architectural Stone."

* * *

TWENTY-FIVE YEARS AGO the building department of the City of Chicago was being censured for its attitude toward hollow concrete blocks, but Editor Harper of CONCRETE believed the attitude not unjustified. In a news item on the subject he says, "Granting that concrete is an admirable building material, we can hardly expect at this early date, or ever for that matter, for those who have the making of ordinances to believe that a wall of hollow concrete block with a 50 per cent air space is equal to a solid brick wall, or in the absence of thorough tests, that it should be used in a metropolitan city."

* * *

TRIBUTE is paid to Edwin M. Thacher to whose efforts "the successful introduction of reinforced arch bridges in the United States is largely due.

"Almost at the beginning of his work in reinforced concrete Mr. Thacher perceived that the shearing stresses in a bridge arch were practically negligible and therefore he saw that the web of the Melan ribs, which type of arch was the most used up to that time, could be safely omitted with a considerable saving in metal. It is safe to say that at present there are more Thacher arches in the United States than any other kind."

* * *

MUCH of the March, 1906, issue of *Cement Age* is occupied by articles and illustrations on houses. I. M. Ladnek reviews the building field of the five previous years. Kendall Banning gives plans and estimates of two cottages of cinder concrete then being built within 20 miles of New York City, one costing $3900 and the other $7400.

* * *

THEODORE STARRETT, president of the Thompson-Starrett Company of New York, describes the concrete foundation work recently completed on the terminal station then under construction at Washington, D. C.

* * *

THE rapid construction of an industrial plant without benefit of detail plans, at Sprague Falls, Maine, in which considerable concrete was used, is told by O. N. Manners. The St. Croix Paper Company in February decided to build a concrete dam 2,000 feet long, three paper mills, accessories for a plant, as well as a town accommodating 2500 people.

Concrete work began in April and all buildings were closed in before severe cold weather, Manners relates in giving the details.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.

American Standards Association; P. G. Agnew, Secretary, 29 West 39th St., New York City.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.
Annual meeting, June 22-26, Stevens Hotel, Chicago.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.
Seventeenth annual meeting, April 21-24, Toronto, Ont., Canada.

Canadian Engineering Standards Association, 178 Queen St., Ottawa, Ontario.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.
Seventh annual meeting, March 16-18. Edgewater Gulf Hotel, Biloxi, Mississippi.

Engineering Institute of Canada; 2050 Mansfield St., Montreal, Quebec.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 W. Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.
Annual meeting, May 20-21, Neil House, Columbus, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Bldg., Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.
Annual meeting, May 12-16, Toronto, Ontario, Canada.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.
Thirteenth annual convention, June 3-4, White Sulphur Springs, W. Va.

National Ready-Mixed Concrete Association; Headquarters, 27 Barbeau St., Pittsburgh, Pa.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Bldg., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Bldg., Cleveland, Ohio.

National Terrazzo and Mosaic Association; U. F. Durner, Secretary, 809 St. Paul Ave., Milwaukee, Wis.
Annual convention, April 27-30. Biltmore Hotel, Atlanta, Georgia.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

New Equipment and Materials

New Barber-Greene Bucket Loader for Box Cars

Originally designed for unloading bulk cement from box cars, the use of the Barber-Greene Model 63 bucket loader has been extended to the loading of wheelbarrows, buggies or conveyor hoppers. The loader handles any bulk material with lumps not exceeding 4 in., at the rate of ½ yd. per minute, according to the Barber-Greene Company, Aurora, Illinois.

Operatable inside a box car, the new loader is wheel-mounted and self-feeding and is powered by a 5 h.p., 1,800 r.p.m. ball-bearing electric motor. The motor is totally enclosed in the machine, and fan cooled.

A pawl and ratchet feeding mechanism is used for crowding the machine into the material. By reversing the pawl, the feeding drive is reversed for backing out of the material. A simple arrangement on the pawl and ratchet makes five feeding speeds available in both directions.

The material is fed into the buckets of the Model 63 loader by means of a spiral ribbon type feeder. The diameter of the ribbon is 24 in. and the machine makes a cut 4 ft. wide. Special welded steel buckets 10 by 4¾ by 6 in. spaced 8 in. apart on a combination steel and MI chain are used. The whole bucket line is housed to create a minimum of dust when handling bulk cement or like material. For loading wheelbarrows or buggies a canvas chute is hung from the discharge end, conveying the material directly downward from the discharge end without creating dust.

When in working position, the new loader is 7 ft. high, 6 ft. 9 in. long, and 4 ft. wide.

Clean-Cut Units Produced on Multiplex Vibrationless Machine

Practically vibrationless and without sprockets, gears, or chains, the new Multiplex tamper presents, combined, for the first time several new improvements. It can be operated either automatically or semi-automatically, producing a clean-cut block with a finished surface on all sides. By using separate mold boxes or adjusting one mold box, all sizes of block, tile and back-up units may be produced.

With a tamper drive shaft that is properly hung, and vibration or hard rebound of tamp bars reduced to the minimum, the blow of the tamper is the only noise heard.

To start the tamper, the operator pulls the starting lever and the material is automatically fed into the stripper mold box before the tamping bars are released. The required amount of material is deposited for each blow by means of a positive feeding device. Any number of blows can be struck. These features, its is expected, will prove most valuable in cinder and lightweight aggregate plants, where proper distribution of material and tamping is essential.

The stripper mold box may be removed from the base and the downface block attachment can be added in a short time, it is stated. Either cast iron or steel pallets may be used for the stripper or downface block, according to the Multiplex Concrete Machinery Company, Elmore, Ohio.

Hydraulic Cartridge for Breaking Concrete or Rock

An improved method for breaking concrete or rock where the use of dynamite is prohibited is being used by the Hydraulic Concrete Breaking Company, Detroit, Michigan. The device used is the portable Hydraulic Cartridge, operated by one man.

The first operation consists of drilling a hole 4½ in. in diameter to a depth of 18 to 20 inches at point previously plotted by the engineer.

The cartridge is placed in the hole, pressure applied and in three to five minutes the concrete is broken. The entire procedure, including the hole drilling, requires 17 to 20 minutes.

As much as 100 cu. yds. of concrete foundations have been removed in a single week, it is stated. The concrete may be broken up in any size from five to ten ton chunks, down to man-handling sizes.

Aluminum Saves Weight in Ready-Mix Agitator Body

The use of aluminum, instead of steel in the agitator body part of a new transit mixer truck manufactured by the Concrete Transport Mixer Company, 650 Rosedale avenue, St. Louis, Missouri, is said to save 1,000 lb. in the weight of the 1-yard truck.

The weight of the truck and chassis is 5,600 lb. and that of the mixer and agitator is 2,000 lb., whereas with steel construction the latter weight would be 3,000 lb., it is stated.

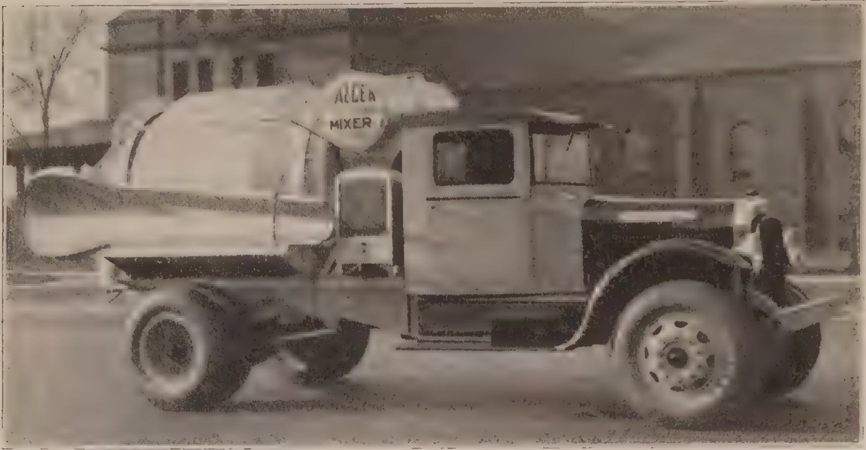
Other special features claimed for this truck include a spiral rotor that is said to accomplish complete mixing and uniform agitation throughout the mass of concrete. The truck discharges through a side spout, though a rear discharge can be supplied by the manufacturer.

Drawing Board Top for Pencil Use Perfected

The "No-Ink" is a new type of drawing board top designed to eliminate inking of drawings. The regular drawing paper is attached directly to its surface. All lines are drawn with a double stroke and with a slight pressure on the pencil. The pressure of the first stroke ridges the paper, and the back stroke fills the valley evenly with lead. The result is a solid opaque, even-edged line, from which excellent reproductions are said to be possible.

The top is manufactured by the W. H. Long Company, Chicago.

Jaeger Ready-Mixing Unit Mounted on Federal Chassis

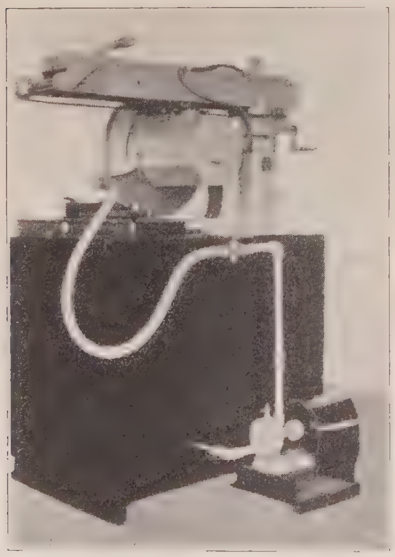


One of the Jaeger Machine Company's contributions to ready-mixed concrete equipment for road building or structural work is the Federal chassis equipped as shown.

Concrete may be pre-mixed or mixed in transit, and the time can be extended to a period of two hours or the drum speeded up and the mixture completed in two minutes. No hoist is necessary, the drum discharging without tilting.

The chassis has a 6-cyl., 90 h.p. engine, 7-speed transmission, full-floating worm drive, rear axle and 4-wheel Westinghouse air brakes.

De Walt Brings Out Cinder Block and Cast Stone Cutting Equipment



The cutting or scoring of cinder block or cast stone is possible with a new, portable unit, designed especially for the purpose, brought out recently by the De Walt Products Corporation, Lancaster, Pa. Straight, angle, or compound cuts are possible.

It applies the principle of direct drive power, and employs a totally enclosed, dust-protected and water-protected, either 4 or 8 h.p. motor, operating at 1,750 r.p.m. Water is used on the wheel to insure greatest efficiency and longest wheel wear.

The Model N machine, for permanent installation and equipped with a 4 h.p. motor, is quoted at $825.00.

Sander for Quick Removal of Form Marks

Removing cement from forms with a great saving of time is one of the many purposes of the new U. S. disc sander.

It embodies a powerful universal motor that operates on ordinary lighting current — 100 and 220-volt, 60 cycles or less. SKF ball bearings, aluminum body, two-pole short proof switch, twelve feet of flexible rubber-covered cable, and two-piece unbreakable attachment plug are included as standard equipment.

This sander is obtainable in two sizes—7 in., weighing 10 lbs., and 9 in., weighing 12½ lbs. It is a product of the United States Electrical Tool Company, Department 103, Cincinnati, Ohio.

M & M Cleating Clamp New Form Device

A new product of the M & M Wire Clamp Company, Minneapolis, Minn., is the cleating clamp, for drawing forms and lumber together before the cleats are nailed on. The clamp is designed to eliminate screw threads, sliding dogs, and other similar devices. It is self-cleaning and undamaged after contact with concrete or mud.

The clamp, it is stated, has perfect adjustment and continuous takeup, and is locked or released by one or two blows of the hammer.

The range of adjustment is from 10 to 36 in. and with the use of an extender, longer.

Amsco Road-Building Dipper's Front Features

The American Manganese Steel Company, Chicago Heights, Illinois, has been granted an exclusive license to sell the Voit dipper front covered by U. S. Patent 1,719,576.

This front, while of the general design used ordinarily on power shovel dippers, has as its distinctive feature a provision for several scraper blades on the outside, one of them running transversely at the heel of the front, and two in a V-shaped arrangement farther toward the lip. There may be additionally a longitudinal one between the V-blades, still farther up.

The sockets holding the scraper blades are cast integrally with the front, and the blades are held in place by wedge shaped parts riveted into the sockets alongside the scraper blades.

A factor of economy is the transverse scraper at the heel of the front, which protects the dipper latch from mud and similar material.

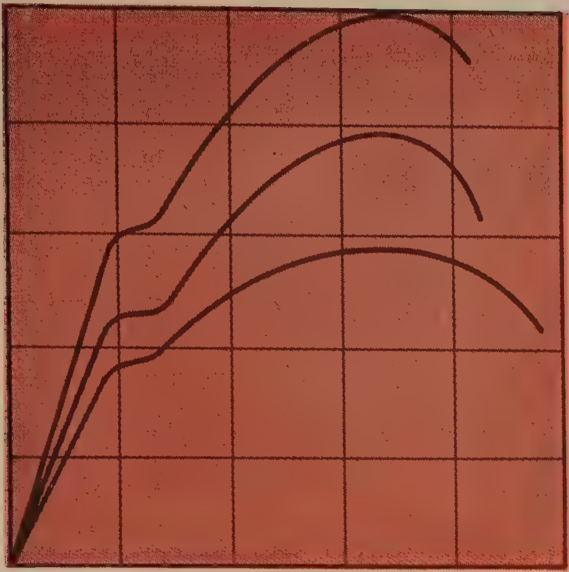
While designed originally for coal stripping, the Voit front can give a uniform grade in street or road work, leaving a smooth, clean bottom to receive the paving material. It will also work out well in cutting slope in road building. Voit fronts in such work would require only the transverse scraper at the heel of the front.

Voit fronts made of Amsco manganese steel can be made for any dipper, although for the Vanderhoef design only the transverse rib is supplied.

Vesicullite Aggregate Is Patented by Los Angeles Man

Patent has been allowed covering a process of producing light-weight vesicular aggregate, known as Vesicullite.

It is manufactured from clay, using ceramic fluxing material and is the invention of Knox Harding, Los Angeles, California.



HIGH ELASTIC LIMIT is the outstanding physical characteristic of rail steel reinforcing bars. HIGH ELASTIC LIMIT is the essential of present day reinforced concrete design; the safety factor is proportionately increased within limitations of bond considerations; the resistance to crack formation either from temperature stress or overload, is noticeably greater; resistance to impact and shock is a maximum—tests have demonstrated all this. Engineers who choose materials carefully, specify reinforcing bars of high elastic limit. Rail steel and intermediate grades are the favorites of modern design standards. Rail steel is produced by an associated industry that marks its product to designate source and quality—this is our service to the discriminating engineer.

• • •

Buffalo Steel Company	Tonawanda, N. Y.
Calumet Steel Company	Chicago, Ill.
Connors Steel Company	Birmingham, Ala.
Franklin Steel Works	Franklin, Pa.
Laclede Steel Company	St. Louis, Mo.
Missouri Rolling Mill Corporation	St. Louis, Mo.
Pollak Steel Company	Cincinnati, Ohio
West Virginia Rail Company	Huntington, W. Va.

Mills in Canada:

Burlington Steel Company Limited	Hamilton
Canadian Tube and Steel Products Ltd.	Montreal

For further information write

Rail Steel Bar Association, Builders Building, Chicago

SEND

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Industrial Literature

Concrete Factories

Rex Concrete Factories is a new booklet dealing with three types of plants—wet, dry, and shrinkage. It gives complete information on Rex Moto mixers for dry plants, Moto remixers for shrinkage plants, and Moto agitators for wet plants, as well as engineering data on elevators and Stearns belt conveyors for concrete factories of all types. This is *Catalog No.* 205, and is published by the *Chain Belt Company*, Milwaukee, Wis.

Other new publications are Catalogs No. 204, covering construction equipment such as mixers, pumps, and saw rigs, and No. 206, illustrating the Rex Champion paver and road pump for 1931.

Testing Standards and Equipment

The subject of the folder, "*The Accepted Standard of Sieve Analysis*" is the *Tyler* standard screen scale testing sieve. The importance of using an accepted standard for testing is stressed.

The fixed relation between sieves is explained. The screen scale is given and the actual opening sizes are shown.

A brief description is also given of the *Ro-Tap* testing sieve shaker, a mechanical device for uniform movement.

Both products are made by the *W. S. Tyler Company*, Cleveland, Ohio.

S-A Ready Mixing Plant Design

The result of *Stephens-Adamson* engineering research in the ready-mixed concrete field is embodied in an automatic proportioning system. This system, and the design and equipping of a plant, is the subject of an excellent, attractive publication of 10 pages published by the *Stephens-Adamson Company*, Aurora, Ill.

Several types of plants are shown in a blue-print type of illustration and briefly described.

Compressor Bulletin

Among the publications issued recently by the *Gardner-Denver Company*, Quincy, Illinois, is the second edition of *Bulletin No. HAC-36*, on duplex horizontal compressors. Twenty-four pages in length, it catalogs the units, both single- and two-stage, completely.

Face-Plate Vibration Booklet

Face-plate vibration is the subject of an 8-page, 8½ by 11-in. booklet published by *Abram Blue Ribbon, Incorporated*, Detroit, Michigan.

The desirable effect of vibration, and the vibrating of dry-mixed facings, wet-mixed facings with and without the use of matrices, are described. Illustrations show several machines equipped with the device.

Ransome Mixer Bulletin

Bulletin 127, issued recently by the *Ransome Concrete Machinery Company*, Dunellen, N. J., deals with the Ransome 14-S standard building mixer.

The unit, designed for a full three-bag batch of 1:2:4 concrete, has blades so arranged as to produce the same mixing action as larger Ransome units.

Several views of the mixer are shown and specifications are given.

Curing Report

The Columbia Products Company, Barberton, Ohio, has issued a new "*Report on the Current Practice of Using Calcium Chloride for Curing Concrete in Pavements, Building Construction, Bridges, Culverts, and Concrete Products,*" known as *No. 30-750.*

Eight pages in length, it is addressed to architects, contractors, and engineers, and goes into all phases of the subject.

Colloy and Its Advantages

A new 4-page folder tells about the properties of *Colloy*, a colloidal concrete admixture manufactured by the *Colloy Products Company*, St. Louis.

Some dozen advantages its use in concrete brings about are listed. Illustrations show its water absorption capacity, structures in which it has been used, and a table gives its chemical analysis.

Union Products Supplement

The Union Steel Products Company, Albion, Michigan, has issued a supplement, on Union road building accessories, to its building specialty catalog *No. 229.* Bar supports, spacers, bridge accessories, etc., are covered.

A new price list on such devices accompanies the supplement.

Butler Bin-Clinton Folder

New literature available on *Butler Bin* equipment and *Clintonized* concrete is an 8-page reprint of articles describing two ready-mixed concrete plants.

The circular is available from either the *Butler Bin Company*, Waukesha, Wisconsin, or the *Clinton Motors Corporation*, Reading, Pa.

Economical Truck Mixer

The *Lee* truck-mounted mixer and its thoroughly individual features are described in a 4-page leaflet prepared recently by the *Lee Transit Mixer Company*, Indianapolis, Indiana. Two of its features are the ability to lift the drum off the truck by derrick or crane at the job and use as a bottom dump truck, and to detach the Lee-mix unit from the truck chassis at any time when the latter may be needed for other purposes.

Other advantages are listed and specifications given.

The Lee-Mix, a 1-yd. unit, may be mounted on any light truck chassis, it is stated, and cuts cost of concrete work by 25 to 40 per cent.

Lift Truck Models

A broadside, entitled "*Built Rugged for Service,*" showing and describing the latest lift truck models, has just been issued by the *Crescent Truck Company*, Lebanon, Pa.

A number of types are illustrated in various uses, and users testify to the service secured.

Hoist Publication

Among the literature distributed by the *Sullivan Machinery Company*, Chicago, at the road builders' recent exposition was *Bulletin No. 76-G*, on electric portable hoists. Their leading points are described briefly and numerous photographs illustrate their use.

Notes From the Field

New Universal Crusher Policy

Effective February 7th, all equipment sales made by the *Universal Crusher Company*, Cedar Rapids, Iowa, will be handled direct with the user or through local jobbers.

Satisfactory dealer connections established for many years will be retained and new connections made in all other sections of the country. Stocks that have been carried at strategic points will be transferred to the Universal Crusher Company's own agents. The Universal lines which have been on the market for over a quarter of a century, will have many additions and a diversified line of crushing, conveying, screening, washing and loading equipment made immediately available.

MILL SECTION of
Concrete

CEMENT PLANT ENGINEERING

New Plants Complete
Existing Plants Modernized
Plans and Equipment for all Departments

FLS

F. L. SMIDTH & CO.
Engineers
225 Broadway ✓ ✓ New York

Index to Advertisers on Page 75 of This Section

More holes to the blast.. Fewer misfires!

with these new *and* improved

BLASTING MACHINES

Developed by General Motors for du Pont, these new blasting machines are now offered to save you money in blasting operations!

The NEW du Pont No. 5 Blasting Machine . . . known as the No. 5 G. M.—because it was designed by General Motors . . . has proved highly successful in many blasting operations where it is necessary to fire a large number of holes at one time.

Here are the special new features that will recommend No. 5 G. M. to you:

(1) A two-point clutch which makes it possible to send the current out on the firing line at its peak.
(2) A laminated armature and solid core field for building up the maximum current.
(3) A one microfarad condenser to store up the current until the moment of discharge.
(4) Most important of all, a new eight-point breaker of unique design which utilizes the current heretofore wasted as a large spark at the completion of the stroke.

Field windings on the new machine are so placed as to increase its efficiency. There are ball bearings on the armature shaft; and a thrust bearing for the rack bar in the direct line of the thrust instead of offset as formerly.

The new machine has a rated capacity of 100 electric blasting caps. As a matter of fact, it has often fired as many as 125 holes connected in series. The weight of this machine is a little less than 36 pounds.

In quarry and construction work, No. 5 G. M. has proved particularly useful. Its large volume of current at sufficient voltage reduces the chances of misfires from electric leakage.

A number of the features from the No. 5 G. M. machine have been incorporated in the du Pont No. 2 and No. 3 Blasting Machines. These machines are now being manufactured with a two-point clutch, an eight-point breaker switch and a condenser. These improved machines materially reduce the chances of misfires in thirty- and fifty-hole shots.

E. I. DU PONT DE NEMOURS & CO., INC.
Explosives Department
WILMINGTON, DELAWARE

DU PONT
REG. U. S. PAT. OFF.

Index to Advertisers on Page 75 of This Section

MILL SECTION of

Concrete

The Cement Mill Edition of Concrete is edited exclusively for those interested in the manufacture of portland cement. Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition. The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

Volume 38 March, 1931 Number 3

CONTENTS

New Mexican Cement Plant Serves West Coast Territory *(Illus.)* 77
Description outlining equipment being installed in southern plant; raw material.

Chemical Reactions in the Setting of Cement *(Illus.)* 81
Lincoln T. Work and Franklin P. Lasseter of Columbia University describe an investigation made into the chemical processes that occur during setting and hardening.

Editorial 87
Long Kilns—And Other Illustrations.
Where More Sustained Promotion is Needed.

Constitution of Portland Cement Studied by X-Ray Method *(Illus.)* 89
L. T. Brownmiller and R. H. Bogue present their conclusions.

Forty-Three Plants Earn Trophies for 1930 Safety Records 94
New high point reached in safety.

Cement Statistics for January *(Illus.)* 95

Men and Mills 96

Mill Equipment *(Illus.)* 97

About Manufacturers of Equipment 98

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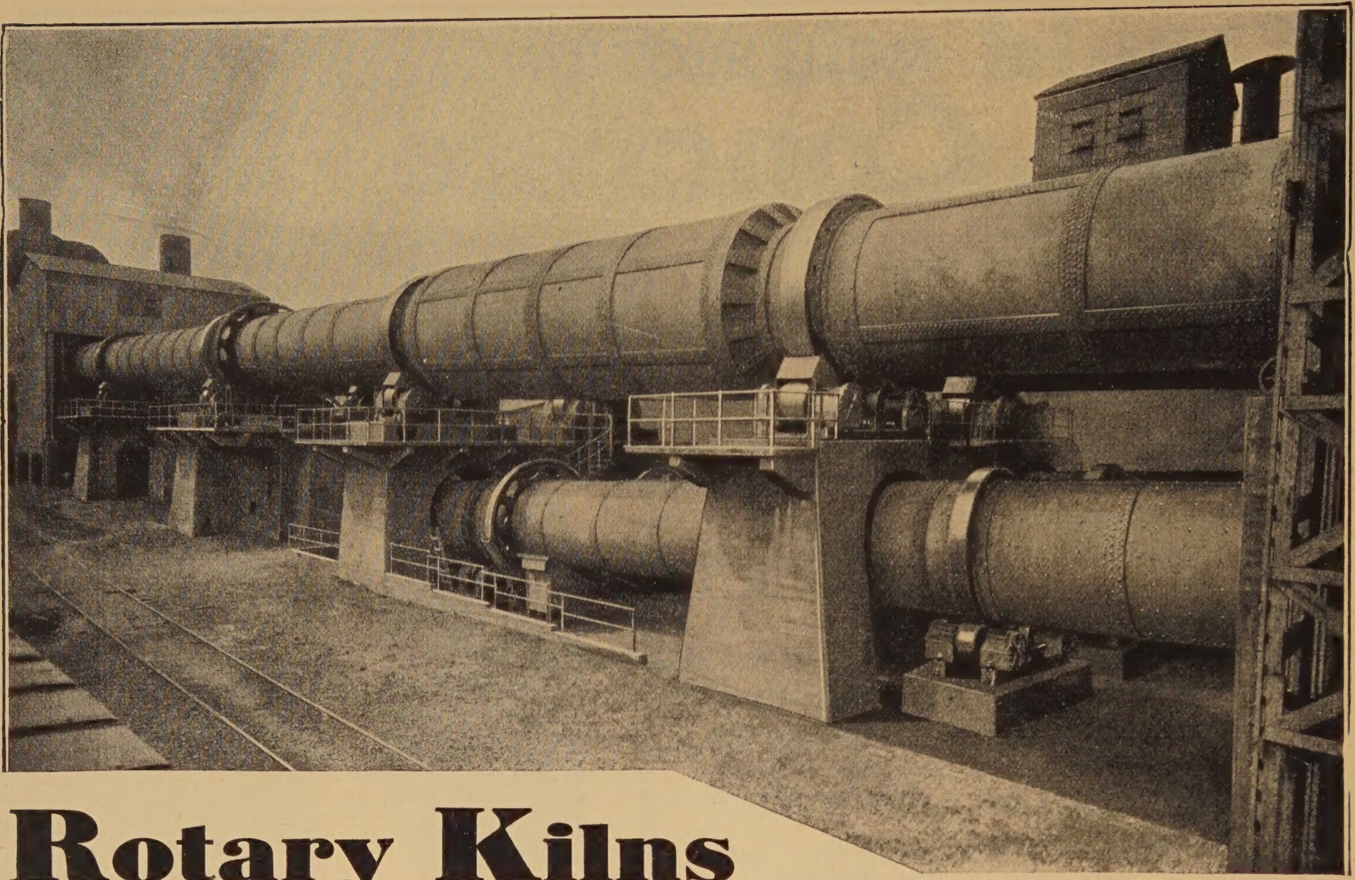
INDEX TO ADVERTISEMENTS

Allis-Chalmers Mfg. Co. 76
Autocar Co. Back Cover
Babcock & Wilcox Co. 101
Burrell Eng. & Const. Co. 103
Chemical Rubber Co. 102
du Pont de Nemours & Co., Inc. 74
Engineering & Designing 70
Fuller Co., The 100
Goodyear Tire & Rubber Co. 99
Jones Fdry. & Mch. Co., W. A. 104
Kritzer Co., The 70
Northern Blower Co. 103
Smidth, F. L., Co. 73
Super Cement Co., The 72



Rotary Kilns

of high efficiency

11′ 6″ x 250′ Four Support Rotary Kiln with Enlarged Calcination Zone and 9′ x 90′ Rotary Cooler.

Cement Mills designed by Allis-Chalmers and equipped with Allis-Chalmers machinery are noted the world over for high efficiency. This is the result of many years experience in designing and building heavy machinery and a policy of continuous research in machinery design.

Rotary Kilns with enlarged Calcination Zones were first built in the United States by the Allis-Chalmers Mfg. Co. This kiln construction has resulted in better heat transference with consequent fuel economy and increased capacity. Allis-Chalmers kilns are of rugged construction with shell plates planed on the edges before rolling, thus insuring a true running shell; bearing pressures are low; riding rings are of the floating type, the latest design kilns having supporting mechanisms of the two roller type with self oiling bearings; thrust rollers have self oiling bearings and are designed to carry the full thrust of the kiln. Driving mechanisms are self contained with motor mounted on a common base. Gears and bearings are self oiling and enclosed. Allis-Chalmers kilns give high operating efficiency.

Allis-Chalmers builds all the principal machinery for cement, crushing, screening, and washing plants, including power and electrical equipment, motors, centrifugal pumps, Texrope Drives, etc.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee